WL-TR-97-3086

CORROSION AND WIDESPREAD FATIGUE DAMAGE OF CRITICAL AIRCRAFT STRUCTURE

D.E. TRITSCH

UNIVERSITY OF DAYTON RESEARCH INSTITUTE
STRUCTURAL INTEGRITY DIVISION
300 COLLEGE PARK
DAYTON, OHIO 45469-0120

SEPTEMBER 1997

FINAL REPORT FOR 07/16/1996 – 09/01/1997

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

FLIGHT DYNAMICS DIRECTORATE
WRIGHT LABORATORY
AIR FORCE MATERIEL COMMAND
WRIGHT-PATTERSON AIR FORCE BASE OH 45433-7542

NOTICE

THIS TECHNICAL REPORT HAS BEEN REVIEWED AND IS APPROVED FOR PUBLICATION.

Thomas B Mills

THOMAS B. MILLS, PROJECT ENGINEER
STRUCTURAL INTEGRITY BRANCH

John T. Ach

JOHN T. ACH, CHIEF
STRUCTURAL INTEGRITY BRANCH

Erica Robertson

for JOSEPH M. MANTER, CHIEF
STRUCTURES DIVISION

REPORT DOCUMENTATION PAGE			*Form Approved* *OMB No. 0704-0188*

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	SEPTEMBER 1997	FINAL REPORT FOR 07/16/1996 - 09/01/1997

4. TITLE AND SUBTITLE CORROSION AND WIDESPREAD FATIGUE DAMAGE OF CRITICAL AIRCRAFT STRUCTURE	**5. FUNDING NUMBERS** C F09603-95-D-0175 PE 62201 PR 2401 TA LE WU 00
6. AUTHOR(S) D.E. TRITSCH	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) UNIVERSITY OF DAYTON RESEARCH INSTITUTE STRUCTURAL INTEGRITY DIVISION 300 COLLEGE PARK DAYTON, OH 45469-0120	**8. PERFORMING ORGANIZATION REPORT NUMBER** UDRI-TR-97-74
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) AIR VEHICLES DIRECTORATE (Formerly - Flight Dynamics Directorate) AIR FORCE RESEARCH LABORATORY AIR FORCE MATERIEL COMMAND WRIGHT-PATTERSON AFB, OH 45433-7542 POC: TOM MILLS, AFRL/VASE, 937-255-6104 EXT. 237	**10. SPONSORING/MONITORING AGENCY REPORT NUMBER** WL-TR-97-3086
11. SUPPLEMENTARY NOTES	
12a. DISTRIBUTION AVAILABILITY STATEMENT APPROVED FOR PUBLIC RELEASE, DISTRIBUTION UNLIMITED	**12b. DISTRIBUTION CODE**

13. ABSTRACT *(Maximum 200 words)*

The effect of corrosion and widespread fatigue damage (WFD) on the structural integrity of USAF aging aircraft could be detrimental to aircraft safety, readiness, and R&M (Reliability & Maintainability) costs. However, with the development and validation of appropriate structural life analysis tools and the supporting data, the effect of corrosion and WFD can be evaluated and therefore managed. But first, the supporting data will need to identify those structural elements which could cause a reduction in aircraft safety, readiness, or R&M when subject to corrosion or fatigue damage. The USAF aircraft fleets selected for consideration included the C/KC-135 Stratotanker, E-8C Joint STARS, C-9A/C Nightingale, C-130 Hercules, and C-5A/B Galaxy.

The overall objective is to create a database, which is useful in identifying trends for the occurrence of corrosion and fatigue cracking damage to airframe Principal Structural Elements (PSEs). The database assembled under this effort contains individual records of Inspection Reports and Repair Orders which have been obtained from standardized USAF damage and repair recording systems (such as OACIS, AIRS, REMIS, AND AFMC202) and from other USAF programs funded to collect specific airframe damage and repair records. This database is not intended to contain all the data, which might be used in a structural integrity evaluation, but it can be used to identify PSEs, which may need further consideration of their structural integrity capability. The trends developed provide real and repeatable evidence to assist in focusing improvement efforts where the largest gains can be made.

(continued)

14. SUBJECT TERMS			15. NUMBER OF PAGES
Corrosion, Cracking			251
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	SAR

13. ABSTRACT *(Continued)*

The results from this project estimate the extent of corrosion and fatigue damage, which exists in the selected USAF aircraft systems. The Pareto trend format is used often to report the results as database record counts in decreasing order grouped by PSE type, location, and the defect type/severity. The results from this effort provide a framework for continuous data gathering and a process for identifying relevant PSEs with corrosion and cracking.

Table of Contents

List of Figures

Figure **Page**

List of Tables

Table **Page**

List of Acronyms

Acronym	Definition
AFMC	Air Force Material Command
AFMC-202	AFMC form 202, PDM Engineering Disposition Repair Records
AFRL	Air Force Research Laboratory (at WPAFB)
AFRL\ML	Materials Directorate of AFRL
AFRL\VA	Air Vehicles Directorate at AFRL
AIRS	Corrosion and Structural Repair Tracking, AFTO Form 58
ALC	Air Logistics Center
AMC	Air Mobility Command
AMMP	Air Mobility Master Plan
DADTA	Durability and Damage Tolerance Assessment
IATP	Individual Aircraft Tracking Point
MDCS	Maintenance Data Collection Systems
MTBC	Mean Time Between Corrosion
NDE/I	Nondestructive Evaluation/Inspection
OACIS	Over and Above Centralized Information System
OC-ALC	Oklahoma City Air Logistic Center
PDM	Primary Depot Maintenance
PSE	Principal Structural Element
R&M	Reliability and Maintainability
REMIS	Reliability and Maintainability Information System
TO	Technical Order
USAF	United States Air Force
WFD	Widespread Fatigue Damage
WL	Wright Laboratory (at WPAFB)
WPAFB	Wright Patterson Air Force Base
WR-ALC	Warner Robins Air Logistics Center

SUMMARY

The effect of corrosion and widespread fatigue damage (WFD) on the structural integrity of USAF aging aircraft could be detrimental to aircraft safety, readiness, and R&M (Reliability & Maintainability) costs. However, with the development and validation of appropriate structural life analysis tools and the supporting data, the effect of corrosion and WFD can be evaluated and therefore managed. But first, the supporting data will need to identify those structural elements which could cause a reduction in aircraft safety, readiness, or R&M when subject to corrosion or fatigue damage. The efforts performed under this program gathered and evaluated existing USAF maintenance data, assembled the data into a database, then used the database to identify airframe structural elements suffering from corrosion or fatigue cracking damage. The USAF aircraft fleets selected for consideration under this effort included the C/KC-135 Stratotanker, E-8C Joint STARS, C-9A/C Nightingale, C-130 Hercules, and C-5A/B Galaxy.

The overall objective was to create a database, which is useful in identifying trends for the occurrence of corrosion and fatigue cracking damage to airframe Principal Structural Elements (PSEs). The database assembled under this effort contains individual records of inspection reports and repair orders, which have been obtained from USAF sources loosely categorized into two groups. The first group is standardized USAF maintenance data collections systems (MDCS) such as OACIS, AIRS, REMIS, and AFMC202. The second group is other USAF programs funded to archive specific airframe damage and repair records. The databases assembled under this efforts are not intended to contain all the data that might be used in a structural integrity evaluation, but it can be used to identify PSEs that may need further consideration of their structural integrity capability. The trends developed provide real and repeatable evidence to assist in focusing improvement efforts where the largest gains can be made.

The results from this project estimate the extent of corrosion and fatigue damage, which exists in the selected USAF aircraft systems. The Pareto trend format is used often to report the results as record count values in decreasing order grouped by PSE

type, location, and the defect type/severity. The results from this effort provide a framework for continuous data gathering and a process for identifying relevant PSEs with corrosion and cracking.

For the C/KC-135, E-8C, C-9A/C, and C-130 fleets of USAF aircraft, some of the overall findings are that the number of records attributed to corrosion are much greater than the records attributed to fatigue cracking. The number of repair records for fatigue cracking may not be well represented by the maintenance data collected. Most fatigue cracks found on an airframe will likely be repaired with a standard repair not requiring a specific engineering action. Most of the data collected under this effort are from maintenance archival systems that only record information from repairs requiring an engineering disposition. The airframe structural elements identified for these four fleets with the highest number of records are the "skins". For the KC-135, the skins are located at the fuselage A/R (Ext.) and the wing (ext.). For the E-8C, the skins are located on the lower fuselage and the aft cargo section between BS 960 – 1440. For the C-9A/C, the skins are located on the wings and the fuselage panels below the floor. For the C-130, the skins are located on the wings.

For the C-5A/B fleet of USAF aircraft, some of the overall findings are that the number of records attributed to fatigue cracking is somewhat higher than the records attributed to corrosion damage. The airframe structural elements identified with the highest number of records attributed to fatigue cracking damage are the fuselage beams & frames. For corrosion damage, the horizontal stabilizer was identified with the highest number of records.

Conclusions from this effort indicate that this effort assembled a viable database and defined a process to identify PSE's with corrosion and cracking. The results indicate that the USAF standardized data recording systems are sufficient to identify PSE's with corrosion and fatigue damage. However, there are no details in standard databases (MDCS) indicating multiple cracks or WFD. The many trial and error efforts to understand the usefulness of all the data gathered and combinations there-of indicate that PSE's can be related to DADTA points with extra data describing the DADTA points. Using the data for the C-130, corrosion & cracking record counts for PSE's are much greater than records counted for DADTA points. Supplemental data gathering

efforts, such as aircraft disassembly and inspection programs, are valuable for substantiation of fleet wide trends, further insight, and additional data.

Recommendations developed from this effort are to continue to collect and evaluate corrosion and cracking trends for the USAF fleets. This database and the process developed here can identify emerging R&M and safety issues. The payoff for R&M across the fleets is in identifying and evaluating corroded PSE's. This database can identify corroded parts and their extent of corrosion damage in the fleet relative to other locations, which then leads to further evaluations of the structural integrity capability. Further data collection can provide payoff for maintenance costs in identifying high drivers by dollars. More accurate data trends can be generated when data entry better adheres to the existing process standards, smart data entry algorithms are installed (allowing only defined tail numbers, MDS, WUC, zone, area, and damage codes), and standardized work zones and areas are created.

SECTION 1

Introduction

1.0 Background/Scope

Swift in Reference 1 discusses the effects of corrosion and widespread fatigue damage (WFD) on the structural integrity of aging transport aircraft. The effect could be detrimental to aircraft safety, readiness, and R&M (reliability and maintainability) costs. However, with the development and validation of appropriate structural life analysis tools and the supporting data, the effect of corrosion and WFD can be evaluated and therefore managed. But first, the supporting data will need to identify those structural elements which could cause a reduction in aircraft safety, readiness, or R&M when subject to corrosion or fatigue damage. The results from this project can provide better focus or direction for planning detailed efforts to determine the extent of corrosion and fatigue damage, which may exist in the selected USAF aircraft systems. The USAF aircraft fleets selected for consideration under this contracted effort are the C/KC-135 Stratotanker, E-8C Joint STARS, C-9A/C Nightingale, C-130 Hercules, and the C-5A/B Galaxy.

In order to provide some perspective to the extent of the issues associated with collecting and evaluating data for a fleet of aircraft, some factual information about the selected fleets is useful. Factual information describing the age, size, and mission of the selected USAF fleets is available from the USAF Fact Sheets via the Internet (as well as most aircraft types currently in service). The Fact Sheets include summary information on the aircraft mission, features, background, general characteristics, date deployed, unit costs, and inventory. The Fact Sheets for each fleet selected for consideration in this effort are included in Appendix A. The selection of these aircraft was made prior to this effort and was based on knowledge of fleet age and potential payoff. Potential payoff considers fleet size, future plans, and potential replacement. The information, which supports the selection, is in part summarized in the USAF Air Mobility Master Plan (AMMP) for 1997. The AMMP 97 presents a summary of the state of the transport fleets which includes Depot Maintenance Intervals, aircraft reliability, aircraft

modifications, current and future sustaining engineering efforts, and service life summaries. Excerpts from the AMMP 97 referring to the selected aircraft fleets are presented in Appendix B.

1.1 Objectives

The intent of this project is to create a database, which can be used to identify, for each selected USAF fleet, trends for the occurrence of damage and repairs to airframe Principal Structural Elements (PSEs) due to corrosion and fatigue cracking. The database (MS Access format) assembled under this effort contains individual records of Inspection Reports and Repair Orders. The inspection and repair data have been obtained from standardized USAF damage and repair recording systems (such as OACIS, AIRS, REMIS, and AFMC202) and from other USAF programs funded to collect specific airframe damage and repair records. This database is not intended to contain all the data that might be used in a structural integrity evaluation, but it can be used to identify PSEs that may need further consideration of their structural integrity capability.

The overall objectives include 1) identifying durability and damage tolerant designed structural elements which may have a reduced life and strength in the presence of corrosion or fatigue damage, and 2) identifying other structural elements which could contribute to a critical failure when subject to corrosion and fatigue damage. To establish the extent of corrosion damage and fatigue cracking in the selected aircraft systems, two technical tasks have been performed. Task 1 involved collecting, reviewing, and consolidating existing basic data on reported damage findings in the selected aircraft. Then, the damage locations were evaluated to identify the damage reported for the structural elements (i.e. DADTA designed structural elements). The basic data includes standard USAF inspection and reliability and maintainability (R&M) data reporting corrosion or fatigue damage data (i.e. OACIS, REMIS, AIRS, and AFMC-202) as well as other USAF funded efforts focusing on damage assessments of fielded aircraft. Task 2 involved categorizing the nature of the damage data as it relates to the aircraft structural integrity, and where possible, quantifies the extent of the damage.

SECTION 2

Task 1 - Assemble and Review Corrosion/WFD Data

2.0 Introduction

This section is organized into subsections, one for each selected aircraft. Each subsection discusses the assembly and initial review of the corrosion and fatigue damage data available for this review. The assembly efforts included gathering the data from identified sources and making modifications needed to improve the querying capabilities of the database. The data sources discussed below may be broadly divided into two groups. The first group is USAF standardized maintenance data collection systems (MDCS) which record information from inspection and repair orders. These include:

- AFMC-202, AFMC Form 202, PDM Engineering Disposition Repair Records
- OACIS, PDM Over & Above Centralized Information System
- AIRS, AFTO Form 58, Corrosion and Structural Repair Tracking, C-130
- REMIS, Reliability and Maintainability Information System

The second group is other USAF funded efforts focused on evaluating or collecting airframe damage and repair records concerning corrosion and fatigue damage. These other USAF funded efforts are either unique (one time) or sustaining programs to evaluate or track corrosion and fatigue damage.

The actual sources and form of the data provided for each fleet are summarized in Table 2.1. The review performed includes a general overview of the database content and its usefulness in being able to identify structural components and the locations with corrosion or fatigue damage. As a result, many modifications were needed to improve the querying capability of the databases. The modifications mostly included adding information (data tables). Table 2.2 summarizes the final form of the databases used in these evaluations including the data table names, number of records, number of aircraft, and the range of the dates for the records. The assembly and review efforts also assisted in identifying a framework and process for data collection and evaluation.

As background for each selected fleet, recall that the USAF Fact Sheets (Appendix A) and the AMMP 97 (Appendix B) present general information concerning the numbers of each model design series (MDS) in the fleet as well as current status and future plans of the fleet.

Most of the data collected under this effort are from maintenance archival systems that primarily record information from repairs requiring an engineering disposition. Therefore, the number of repair records attributed to fatigue cracking may not be well represented by the maintenance data collected here. Most fatigue cracks found on an airframe will likely be repaired with a standard repair not requiring a specific engineering action (such as installing an oversized fastener).

2.1 C/KC-135 Stratotanker

Inspection and repair data were available from two sources. First, a unique program to disassemble and inspect for hidden corrosion was performed by Boeing on a selected EC-135H with tail number 61-0291 (referred to here as the 291 data). The results of this program are documented in laboratory inspection reports identified by References [3] through [7]. The other data source is inspection and repair data records collected by the USAF in a MDCS known as OACIS. For this aircraft, OACIS data primarily includes inspection and repair information from the Program Depot Maintenance (PDM) facilities, which is usually Oklahoma City (OC-ALC).

The C-135 OACIS database was provided by the USAF as indicated in Table 2.1 by data item 1.4. The database was augmented with information defining or describing the database fields and the How Mal Codes (How Malfunction defect code). Table 2.3 lists the information contained in the three data tables made up to be the KC-135 OACIS database (KC135OACIS.mdb). Also included in the listing, are the linking relationships possible between the data tables via a common field entry.

The 291 data is a detailed listing of the corrosion that was found on one aircraft specifically selected and disassembled to find hidden corrosion. The majority of data available from the EC-135H (Tail Number 61-0291) disassembly and hidden corrosion inspection program was originally available in paper form, References [3 – 7]. Each volume documents the corrosion findings by section number for the many sections cut

out from the airframe and then disassembled. Each section in the reports contains two forms of data records, tabular and text records. The Tabular Data quantifies the corrosion depths found on each piece and the Corrosion Damage Reports describe the structural elements of the section and the damage found on each piece.

The Tabular Data contained in the reports was originally available only in the form of printed paper. However, McDonnell Douglas Aircraft (MDA) had, under a separate contract, entered only the tabular data from Volumes 6 and 7 into EXCEL files (see Table 2.1, item 1.1 and 1.2) using a format identical to the printed page format in Reference [6].

The text information contained in the individual Corrosion Damage Reports for all sections of the reports was available in an Access file (see Table 2.1 item 1.3). The file included component description text, damage description text, and a list of damage types with the occurrence indicated by an "x" as a yes/no mark.

Reviews of the 291 data started with the Volume 6 & 7 tabular data along with the corrosion damage reports data (Table 2.1 items 1.1 – 1.3). The review indicated that the form of these data tables was inadequate for Access queries. The mixing of several information types into one column (as seen in any of the data volumes) causes any query efforts to be limited and difficult. It was decided to expand (separate) and add to the information contained in the tabular data files in order to facilitate future queries. This included trying to provide a link between the two data table types allowing the line items to be linked together.

The individual line items of the Tabular Data can, in most cases, be traced to the individual Reports of damage only by manually tracing the numbered photographs referenced by both. The exceptions included cases where a single line item in the tabular data has no or several photograph numbers. This condition also exists in the Reports of Damage Records. It was decided that the two types of data files could, in most cases, be linked within Access by manually adding to each Tabular line item and to each Report line item a single corresponding photograph id number (called a Photo Code). Volumes 1, 5, 6, 7, 8, 9, and 10 of References [3 – 6] were borrowed from WL/FIBE to perform the manual Photo-Code entry. During this process, other modifications were performed on the "Tabular" data and are summarized in Table 2.4

which lists the before and after column heading titles. The database table for Records of Damage Descriptions was also modified to include the Photo-Code and additional fields to trace each record back to the reference report and the disassembled section number. Database tables containing a Database Key and Section Descriptions (for all 271 sections) were also created in order to have a linking capability with the damage data to provide part and damage location information for the disassembled sections. Table 2.5 presents the content information of each data table and the possible relationships between data tables for the final form of the Access database containing the 291 data records (EC135H-291.mdb).

The results from the 291 source will have limited usefulness for this program for two reasons. First, the 291 data represents only one airframe, an EC-135H (not a tanker). This program is focused on evaluating trends, which estimate the extent of corrosion on a fleet of aircraft with several model design series in service and with a broad range of usage. Second, the 61-0291 airframe is reported in Reference [7] to have been through 3 PDM level airframe refurbishment processes specifically for corrosion within a 5-year period prior to the disassembly. Recall that this airframe was selected for disassemble and inspection to find hidden corrosion damage. The results of the 61-0291 disassembly and inspection for corrosion will therefore only indicate the level of corrosion left behind after depot level repairs. The hidden corrosion found and recorded in the 291 database will largely be that found on secondary structural elements, since most primary structure (DADTA and IAT points) are inspected as part of a PDM overhaul.

The 291 data records do however provide extra information describing the corrosion not available in the standardized data collection systems. This extra information includes geometry (area and depth) and location descriptions of the corrosion occurrences. The usefulness of the 291 database is in identifying the locations and depths of the corrosion left behind (missed) after a PDM refurbishment.

In order to assist in identifying the locations of the damage and the damaged parts, "Work Area" descriptions were incorporated into the database. Work Area codes are a field in some of the MDCS databases (such as OACIS) and are predefined area locations on the airframe. For the C/KC-135, Table 2.6 presents the Work Area

descriptions used by the repair facility. The original source of the Work Area description data is described in Table 2.1 as data item 6.1.

2.2 E-8C Joint STARS

Inspection and repair data were available from two sources. First, under a separate one time USAF contract, Northrop Grumman (Lake Charles, LA) collected corrosion and fatigue damage data from the records of "Over & Above" (O&A) repairs to the 707 airframes acquired for conversion to the E-8C Joint STARS (JSTARS) configuration. The original source for the Northrop Grumman O&A data are described in Table 2.1 as data items 2.1 through 2.3. The Northrop Grumman evaluation of selected O&A repair records are summarized in Reference [19] and cover two JSTARS aircraft designated as P3 and P4. The second data source is PDM Over & Above repair records collected by the USAF for the entire fleet in a MDCS known as OACIS. The original source for the OACIS data are described in Table 2.1 as data item 2.4.

Usually, OACIS data records are generated from scheduled PDM level O&A repair orders. However, the E-8C OACIS data for the eight aircraft in the current fleet, were all generated at the Northrop Grumman Lake Charles, LA refurbishment facility. The Northrop Grumman O&A data, reported in Reference [19], are also based on the O&A repair records, but were selected as being notable by severity or location. This database is a more detailed listing of the corrosion and fatigue damage found on just the two aircraft while in the refurbishment process.

The damage data recorded as O&A is that which was reported under the O&A contract guidelines as part of the Northrop Grumman 707 refurbishment program. As a result, the information in the Northrop Grumman O&A database has some common elements to the E-8C OACIS database. The Northrop Grumman O&A database should provide some confirmation of the trends from the E-8C OACIS database as well as some additional detail.

As stated above, repair records attributed to fatigue cracking damage may not be well represented in OACIS since most fatigue cracks found will be repaired using a Technical Order (TO) which does not require a specific engineering action. In addition,

the refurbishment of the 707 airframes included wing skin replacement as a result of the WFD evaluations for the 707 wing structure reported in References [16 – 18].

The E-8C OACIS database covers all eight aircraft in the fleet and the results from evaluations of this database are considered a better trend or estimate of the extent of corrosion and fatigue damage in the fleet. Usually, PDM level inspections and repairs are the most extensive under scheduled maintenance programs. However, since the Northrop Grumman O&A and the E-8C OACIS databases are from an extensive refurbishment program, the number and extent of the repairs will be higher than usual.

Table 2.5 includes summary information describing the final form of the two ACCESS databases used in the evaluations for this program. The E-8C OACIS data tables were augmented with information describing the database fields, the How Malfunction Codes (How Mal or H/M codes), and general aircraft information by tail number. Table 2.7 presents the full content information of the final form of the E-8C OACIS database. The Northrop-Grumman O&A database tables were augmented with information describing the database fields, general aircraft information by tail number, and the work zone location definitions used by Northrop Grumman. The work zone definitions were originally reported in Reference [19] as the sketch shown here in Figure 2.1. Table 2.8 presents the work zone location definitions created from the sketch and now included as a data table in the Northrop Grumman O&A database. Table 2.9 presents the full content information of the final form of the Northrop Grumman O&A database.

In order to assist in identifying the locations of the damage and the damaged parts, "Work Area" descriptions were incorporated into the two databases. Work Area codes are a field in some of the MDCS databases (such as OACIS) and are predefined area locations on the airframe. For the E-8C, Table 2.10 presents the work area and zone descriptions used by the repair facility. The original source of the Work Area description data is described in Table 2.1 as data item 6.1. The Work Zones defined in Table 2.8 (for the Northrop Grumman O&A database) and 2.10 (for the E-8C OACIS database) describe essentially the same zones, but the nomenclature for zone and area is not consistent. Plus, the zones in Table 2.8 apply only to aircraft P3 and P4 while the zones in Table 2.10 apply to aircraft P1 through P10.

In addition, fatigue-cracking data reported in References [16 – 18] was obtained. The original source of this cracking data is identified in Table 2.1 as data item 2.5. These data were developed as part of a wing lower surface tear down performed by Boeing et al. and was reviewed by the E-8C/B707 Blue Ribbon Panel. The results of the review of fatigue cracking in the 707 wing for the JSTARS refurbishment program were reported in Reference [18]. The data primarily includes frequency of occurrence for cracks by location and size found on selected wing spars and skin-panels as part of the tear down and inspection efforts for the 707 wings. The references contain detailed evaluations of the impact of the widespread fatigue damage (WFD) on the safety and residual strength of the wing structure.

As reported in Reference [16], typical fatigue cracks were identified at 2631 hole locations in the inspected structure. Cracking occurred more frequently in the stiffener fastener holes than in the skin fastener holes; 1675 compared to 869. The stiffener hole cracking occurred more frequently at the splices. The large majority of the cracks identified was very small (< 0.010 inches) and may not have been found except for the tear down inspection. The three longest cracks were more than one inch and were found in the stiffeners. These data will not be further reviewed or evaluated under this program since the Blue Ribbon Panel performed and reported results of extensive evaluations for WFD concerns. As a note, the wings disassembled were from aircraft considered to have had a severe usage history. One of the Boeing 707 airframes inspected and refurbished into an E-8C Joint STARS configuration was reported by Northrop-Grumman to have a similarly severe usage history.

2.3 C-9A/C Nightingale

For the C-9 fleet, inspection and repair data were available from one source. That is, PDM Over and Above (O&A) repair records collected by the USAF for the fleet of C-9 Nightingales in a MDCS known as OACIS. The original source of the OACIS data is described in Table 2.1 as data item 3.1. For this aircraft, the OACIS data is collected at OC-ALC from the PDM facilities (primary one being OC-ALC) and includes information from the O&A repair orders.

The OACIS database includes 30 separate tail number entries while the USAF Fact Sheet for the C-9A/C Nightingale in Appendix A identifies only 10 aircraft in the active USAF inventory. The reason for the seeming disparity in the number of active aircraft is unknown. The trends developed from the OACIS database are still considered a good trend or estimate of the extent of corrosion and fatigue cracking damage found and repaired at PDM facilities under the O&A guidelines. PDM depot level inspections and repairs are the most extensive under the scheduled maintenance programs.

The OACIS data tables were augmented with information describing the database fields and the How Malfunction Codes (How Mal or H/M codes). Table 2.11 presents the full content information of the final form of the C-9A/C Nightingale OACIS database (C9OACIS.mdb).

In order to assist in identifying the locations of the damage and the damaged parts, "Work Area" descriptions were incorporated into the database. Work Area codes are a field in some of the MDCS databases (such as OACIS) and are predefined area locations on the airframe. For the C-9A/C, Table 2.12 presents the work area descriptions used by the repair facility. The original source of the Work Area description data is described in Table 2.1 as data item 6.1.

2.4 C-130 Hercules

For the C-130 fleet, corrosion and fatigue damage data were available from four sources. All four sources are inspection and repair data collected by the USAF in standardized maintenance data collection systems archived at WR-ALC and are identified as follows.

- AFMC-202, AFMC Form 202, PDM Engineering Disposition Repair Records
- OACIS, PDM Over & Above Centralized Information System
- AIRS, AFTO Form 58, Corrosion and Structural Repair Tracking
- REMIS, Reliability and Maintainability Information System

AFMC202 and OACIS primarily include information from records of repairs performed at the PDM facility that required an engineering disposition. The PDM facility for the C-130 fleet is WR-ALC. The AIRS database includes information from both depot and field level inspection and repair records recorded on AFTO Form 58, which is

explained in detail in Reference [20]. The REMIS database primarily includes the occurrences of field level repairs for corrosion. The sources of the data from the four database listed above is described in Table 2.1 as data items 4.5, 4.1, 4.6, and 4.4 respectively.

In addition to the repair data described above, a database summarizing information on the C-130 DADTA structural elements was developed by ARINC Corporation under a separate USAF funded effort documented in References [21 & 22]. The source of the ARINC database is described in Table 2.1 as data item 4.3. The ARINC database includes five data tables, which provide information and descriptions on the C-130 model design series (MDS), NDI methods, work unit code (WUC) descriptions, critical component data, and a listing of WUCs versus DADTA points. The critical component data identifies the DADTA points and some of the associated analysis and force management information. Work unit codes are standardized work instructions used as part of depot repair actions. The table of WUCs versus DADTA points lists the DADTA points associated with each WUC. Table 2.13 provides a listing of the C-130 ARINC data tables and their content. The type of information in these data tables is required for associating the damage found and repaired to particular critical structural elements (i.e. DADTA points). Queries of the four repair record databases identified above include several where the ARINC data tables were linked to assist in identifying damage found and repaired on DADTA points.

The repair data for this aircraft has the largest range of sources making the process of linking and querying the databases quite difficult. Work unit codes (WUC) recorded in the repair databases can be used to characterize the extent of the repair. That is, a WUC is specific to an assembly, which includes specific parts at a specific location. Thus, linking the table of WUC versus DADTA points to a repair database with a WUC field can extract or separate the repairs on DADTA points.

The ARINC data describing the critical component data was recorded in a fashion which yielded too many occurrences due to the repeating of DADTA points for each specific C-130 model design series (i.e. C-130A, C-130B, etc.). In addition, the data relating the DADTA points to WUCs includes, for some cases, multiple DADTA points for one WUC and multiple WUCs for one DADTA point. Many trial queries were

made to develop a better understanding of the problems and solution methods. Some level of checking query results against individual data records was always done to better assure the trend rankings. The ARINC data tables finally proved to be quite useful in augmenting the repair databases.

For the C-130 databases, Tables 2.14, 2.15, 2.16, and 2.17 present the full content of the information for the OACIS, AFMC202, AIRS, and REMIS databases respectively. In order to assist in identifying the locations of the damage and the damaged parts, "Work Area" descriptions were incorporated into the databases. Work Area codes are a field in some of the MDCS databases (such as OACIS) and are predefined area locations on the airframe. For the C-130, Table 2.18 presents the work area descriptions used by the repair facility. The original source of the Work Area description data is described in Table 2.1 as data item 6.1.

2.5 C-5 Galaxy

For the C-5 fleet, inspection and repair data were available from the SA-ALC where a sustaining effort by the ALC/LADE group developed and populated the database. The database contains records of structural repairs, which required an engineering disposition. A primary intent of the LADE engineers in developing and maintaining the database was to facilitate repeated and similar repairs. The original source of the SA-ALC database is described in Table 2.1 as data item 5.1. For this aircraft, the PDM facility is (at this time) the SA-ALC. Repairs requiring an engineering disposition are a customized repair being more detailed than a standard repair and usually involve a larger degree of damage or principal (critical) structural elements. The data was recorded in files for each year the repairs were completed and closed. This data has been consolidated into a single ACCESS database referred to in this report as the C5-ALC database.

The C5-ALC database was augmented with information describing the DTA points for the C-5A as defined by Lockheed in the Fracture Analysis Report listed as Reference [24]. This table of DTA point descriptions was transcribed and is shown in Table 2.19. Similar information for the C-5B is available in Reference [23]. The scheme used by Lockheed to designate the DADTA and IAT points in these two references is

different. In addition, the location and count of DADTA points identified for the C-5A are generally not the same locations and count identified for the C-5B. To illustrate this point, the DADTA analysis points for the C-5A and C-5B fuselage sections are shown in Figures 2.2 and 2.3 respectively. These DADTA points are not included in the repair records of the C5-ALC database but would be a useful field if available. Table 2.20 presents the full content information of the final form of the C5-ALC database.

2.6 Summary

To date, the UDRI has gathered the existing data summarized in Table 2.1, which includes the information from inspection reports and repair orders concerning corrosion or fatigue cracking of airframe structure in selected USAF aircraft. The USAF fleets selected for consideration under this effort include the C/KC-135 Stratotanker, E-8C Joint STARS, C-9A/C Nightingale, C-130 Hercules, and C-5A/B Galaxy.

The data gathered and reviewed in this effort may be broadly divided into two groups. The first group is USAF standardized maintenance data collection systems (MDCS) which record information from inspection and repair orders. These include:

- AFMC-202, AFMC Form 202, PDM Engineering Disposition Repair Records
- OACIS, PDM Over & Above Centralized Information System
- AIRS, AFTO Form 58, Corrosion and Structural Repair Tracking, C-130
- REMIS, Reliability and Maintainability Information System

The second group is other USAF funded efforts focused on evaluating or collecting airframe damage and repair records concerning corrosion and fatigue damage. These other USAF funded efforts are either unique (one time) or sustaining programs to evaluate or track corrosion and fatigue damage. These include the following four efforts. 1) The Northrop-Grumman effort, summarized in Reference [19], reporting on the "Over & Above" repairs to two of the 707 airframes converted to Joint STARS configured aircraft. 2) The ARINC effort, summarized in References [21 and 22], to assess the corrosion damage on critical structure components of USAF C-130 Aircraft. 3) The Boeing effort, summarized in References [3 – 7], to assess the hidden corrosion found on the EC-135H with tail number 61-0291 during a tear down and

disassembly effort. 4) The USAF Kelly AFB SA-ALC/LADE sustaining effort to control and repair damage primarily caused by corrosion and fatigue on the C-5 airframe.

The efforts to assemble useful databases that would achieve the program objectives included making modifications needed to improve the querying capabilities of the database. The primary objective of the program is to estimate the extent of corrosion and fatigue damage in the selected USAF fleets. The intent of this project is to create a database that can be used to identify trends for the occurrence of damage to airframe Principal Structural Elements (PSEs) caused by corrosion and fatigue cracking. This database is not intended to contain all the data that might be used in a structural integrity evaluation, but it can be used to identify PSEs which may need further consideration of their structural integrity capability in the presence of corrosion and fatigue damage. A summary of the final form of the MS ACCESS databases assembled in this program is listed in Table 2.2.

A conclusion from the general review of all the repair data discussed above is that two database characteristics are needed to better meet the intent of this program. The databases should include data for the entire selected aircraft fleet and data primarily collected from the scheduled depot level maintenance actions. Data collected for a limited number of aircraft may not well represent the average or the extreme extent of corrosion and fatigue damage that exists in a fleet. In addition, the depot level maintenance actions are a more consistent source of data and usually involve most of the PSEs for a selected aircraft fleet. The two sources of corrosion and fatigue cracking data that include these two characteristics are the USAF MDCS known as OACIS and AFMC202.

The trends developed from inspection and repair data gathered from unique programs, which were funded to evaluate corrosion or fatigue damage on "selected" aircraft, are useful for two reasons. First, they provide validation of the trends developed from the standardized MDCSs. Second, they provide additional detail not available in the MDCSs that will supplement and provide added insight into the fleet wide trends. Examples of such unique programs are documented in References [3 – 7, 16 and 19].

As a note, the extent of fatigue cracking (and WFD) which exists in the USAF fleets will likely not be well characterized by the data gathered from the MDCSs. As

indicated by the 707-wing tear down and inspection efforts documented in Reference [16], most of the fatigue cracks would not have been found during PDM actions. In addition, if a fatigue crack were indicated at a fastener hole from an NDI procedure, then a standard repair that is documented in a Technical Order (TO) repair instruction would call for over-sizing the hole and installing a larger fastener. This type/level of repair does not require an engineering disposition and may not be well recorded in a MDCS.

Table 2.1 (2 sheets) Data gathered concerning corrosion and widespread fatigue damage (WFD) on airframe structure of selected USAF aircraft.

Data Item	Model	Data File Name /Type Original Form	Data Source	Provided to UDRI by:
1.1	KC-135 EC-135H, 61-0291	HCPVol6.xls, Excel	Volume 6 of Ref [6] - Created by MDA	WL/FIBEC (C. Paul)
1.2	KC-135 EC-135H, 61-0291	DHCPVol7.xls, Excel	Volume 7 of Ref [6] - Created by MDA	WL/FIBEC (C. Paul)
1.3	KC-135 EC-135H, 61-0291	Boeing1.mdb, ACCESS	Ref. [3 – 6], All volumes - Text Information from the individual "Corrosion Damage Reports". Created by Boeing at OC/ALC, 1099 records	WL/FIBEC (C. Paul)
1.4	KC-135	KC135.zip (1 disk), compressed Access	USAF OACIS data, extracted by ARINC at OC-ALC/LCRA	WL/FIBEC (C. Paul)
2.1	Joint STARS	JSTAR1.mdb, ACCESS - Aircraft info. - O&A data	Northrop-Grumman, data recorded as part of J* refurbishment	WL/FIBA (D. Groner)
2.2	Joint STARS	JSTAR2.mdb, ACCESS - Aircraft info. - O&A data	Northrop-Grumman, enhanced version of JSTAR1, item 2.1	WL/FIBA (D. Groner)
2.3	Joint STARS	JSTAR3.mdb, ACCESS - Aircraft info. - O&A data	Northrop-Grumman, enhanced version of JSTAR2, item 2.2	WL/FIBA (D. Groner)
2.4	Joint STARS	jstar.zip (2 disks), compressed Access	USAF OACIS data, extracted by ARINC at OC-ALC/LCRA	WL/FIBEC (C. Paul)
2.5	Joint STARS	counts.xls Excel, 4.252 MB	Reference [16 – 18]	Boeing, Wichita, KS (J. Luzar)
3.1	C-9	OACIS.zip, compressed Access	USAF OACIS data, extracted by ARINC at OC-ALC/LCRA	WL/FIBEC (C. Paul)
4.1	C-130	airs.zip (1 disk), compressed database	USAF AIRS data, extracted by ARINC at OC-ALC/LCRA	WL/FIBEC (C. Paul)
4.2	C-130	images.zip (4 disks), compressed image files.	USAF C-130 DADTA control point images, developed by ARINC at OC-ALC/LCRA	WL/FIBEC (C. Paul)

Table 2.1 (2 sheets) Data gathered concerning corrosion and widespread fatigue damage (WFD) on airframe structure of selected USAF aircraft.

Data Item	Model	Data File Name /Type Original Form	Data Source	Provided to UDRI by:
4.3	C-130	C130-DB.zip, compressed ACCESS	ARINC, summarizes the DADTA control points, References [22]	WL/FIBEC (C. Paul)
4.4	C-130	REMIS.zip, compressed ACCESS	USAF REMIS data, extracted by ARINC at OC-ALC/LCRA	WL/FIBEC (C. Paul)
4.5	C-130	AFMC-202.zip, compressed ACCESS	USAF AFMC-202 corrosion data, extracted by ARINC at OC-ALC/LCRA	WL/FIBEC (C. Paul)
4.6	C-130	OACIS.zip, compressed Access	USAF OACIS data, extracted by ARINC at OC-ALC/LCRA	WL/FIBEC (C. Paul)
5.1	C-5	CLOSD88.mdb, CLOSD89.mdb, CLOSD90.mdb, CLOSD91.mdb, CLOSD92.mdb, CLOSD93.mdb, CLOSD94.mdb, CLOSD95.mdb, CLOSD96.mdb, CLOSD97.mdb Access 2.0	SA/ALC/LADE C. Hitchings Data from C-5 engineering dispositions of corrosion repairs	WL/FIBA (D. Groner)
6.1	C-130 C/KC-135 C-9 E-8C + 16 other DoD aircraft	WorkAreas.xls MS Excel	DLA, GA	WL/FIBA (D. Groner) DLA (D Jones)

Table 2.2 Summary Information for Each Database

Database File Name:	Table Name:	Number of Records:	Number of Aircraft	Date Range
EC135H-291.mdb	Volume 1,5,6,7,8,9,10	3331	1	Aircraft #61-0291
EC135H-291.mdb	Part & Corrosion descriptions	1099	1	Aircraft #61-0291
EC135H-291.mdb	Section Descriptions	271	1	Aircraft #61-0291
EC135H-291.mdb	Database key	31	1	Aircraft #61-0291
KC135OACIS.mdb	KC136 OACIS	5883	279	10/90 - 7/96
KC135OACIS.mdb	How Mal Codes	11		
KC135OACIS.mdb	OACIS Field Descriptions	13		
JSTARSNG3.mdb	J*AIRCRAFT INFO	6	2	1996
JSTARSNG3.mdb	O&A DATA	1536	2	1996
JSTARSNG3.mdb	J* O&A Field Descriptions	27		
JSTARSNG3.mdb	J* Zone Loc & Descrip	36		
JSOACIS.mdb	How Mal Codes	11		
JSOACIS.mdb	J* AIRCRAFT INFO	6	8	
JSOACIS.mdb	J*OACIS	33442	8	1/92 - 9/96
JSOACIS.mdb	OACIS Field Descriptions	13		
C9OACIS.mdb	C9 OACIS	12950	61	8/90 - 8/96
C9OACIS.mdb	How Mal Codes	11		
C9OACIS.mdb	OACIS Field Descriptions	13		
C130Arincdb.mdb	Critical Component Data	241		
C130Arindb.mdb	MDS	3		
C130Arincdb.mdb	NDI Method	8		
C130Arincdb.mdb	WUC Descriptions	875		
C130Arincdb.mdb	WUC vs DADTA Point	451		
C130AFMC202.mdb	202 Data	1003	127	Jan 94 - Apr 96
C130AFMC202.mdb	202 Field Descriptuons	14		
C130AFMC202.mdb	Damage Classification	31		
C130AFMC202.mdb	Engineers	27		
C130AFMC202.mdb	Locations	50		
C130AFMC202.mdb	Planners	54		
C130AFMC202.mdb	Solutions	4		
C130OACIS.mdb	Critical Component Data	241		
C130OACIS.mdb	How Mal Codes	11		
C130OACIS.mdb	OACIS	8065	101	Sep 90 - May 96
C130OACIS.mdb	OACIS Field Descriptions	13		
C130OACIS.mdb	WUC Descriptions	875		
C130OACIS.mdb	WUC vs DADTA Point	451		
C130REMIS.mdb	Critical Component Data	241		
C130REMIS.mdb	GeoLoc Codes	46	447	
C130REMIS.mdb	REMIS	2922	447	NA
C130REMIS.mdb	REMIS Field Descriptions	8		
C130REMIS.mdb	WUC Descriptions	875		
C130REMIS.mdb	WUC vs DADTA Point	451		
C130Airs.mdb	C130 AIRS	3769	116	Jan 91 - Jul 96
C130Airs.mdb	Airs Field Discriptions	27		
C130Airs.mdb	How Mal Codes	3		
C5-ALC.mdb	ALL88-96	4302	124	1988 - 1996
C5-ALC.mdb	C5A DTA Points	77	C-5A	
C5-ALC.mdb	CLOSD88	11	2	1988
C5-ALC.mdb	CLOSD89	425	17	1989
C5-ALC.mdb	CLOSD90	541	20	1990
C5-ALC.mdb	CLOSD91	558	17	1991
C5-ALC.mdb	CLOSD92	373	21	1992
C5-ALC.mdb	CLOSD93	527	33	1993
C5-ALC.mdb	CLOSD94	706	37	1994
C5-ALC.mdb	CLOSD95	642	39	1995
C5-ALC.mdb	CLOSD96	519	38	1996
C5-ALC.mdb	CLOSD97	3	2	1997

Table 2.3 Content Information for the KC-135OACIS.mdb Database.

Database File Name:	KC135OACIS.mdb	KC135OACIS.mdb	KC135OACIS.mdb
Table Name:	KC136 OACIS	How Mal Codes	OACIS Field Descriptions
Number of Records:	5883	11	13
Number of Aircraft	279		
Date Range	10/90 - 7/96		
Column Names:	Record	Record	Record
	Work Request Number	How Mal Code	OACIS Field
	Date Reported	Description	Field Description
	Work Unit Code		
	How Mal		
	Action Taken Code		
	When Discovered Code		
	Work Area		
	Work Zone		
	Discrepancy		
	Corrective Action		
	Tail Number		
Relationships:	How Mal	How Mal Code	

Table 2.4 EC-135H 61-0291 Data Column Headings for Tabulated Records Showing the Original and Modified Forms.

Original	New & Improved
Section #	Record
Part ID/Photo #	A/C Model
Alloy/Form	Source
Thickness	Title
Surface Description	Reference Number
Total Area	Vol
Corrosion % Area	Section Number
Corrosion Depth min	BS
Corrosion Depth max	WS
	WL
	BL
	HS
	Part identification
	Part number
	Photo number
	PHOTO_CODE
	Alloy
	Clad
	Form
	Thickness
	Surface description
	Total area
	Corroded area
	Minimum depth
	Maximum depth
	Corrosion description
	Crack description
	Crack size

Table 2.5 Content Information for the EC-135H-291.mdb Database.

Database File Name:	EC135H-291.mdb	EC135H-291.mdb	EC135H-291.mdb	EC135H-291.mdb
Table Name:	Volume 1,5,6,7,8,9,10	Part & Corrosion descriptions	Section Descriptions	Database key
Number of Records:	3331	1099	271	31
Number of Aircraft	1	1	1	1
Date Range	Aircraft #61-0291	Aircraft #61-0291	Aircraft #61-0291	Aircraft #61-0291
Column Names:	ID	SECTION_NO	Record	Record
	Vol	REPORT_NO	Section number	Field
	Report #	PART_DESCR	Section Description	Abbreviation
	Section Number	PHOTO_NO	Section	Description
	A/C Model	PHOTO_CODE	Sub Section	
	Serial #	PRESSURE	FS	
	Source	SKIN_LAP	WS	
	Title	SKIN_BUTT	HS	
	Reference #	STRINGERS	VS	
	BS	EDGE_SKIN		
	VS	LATRINE		
	WS	SPOTWELDJO		
	WL	REPAIRED		
	WBL	FRAMES		
	BL	SPOTWELDS		
	HS	FASTENERS		
	Part identification	UNBONDED		
	Part number	PRIMED		
	Photo number	SEALED		
	Photo_Code	DETERIORAT		
	Alloy	INSPECTABL		
	Clad	TRAPS_DIRT		
	Form	DAMAGED		
	Thickness	STRESS_COR		
	Surface description	EXFOLIATIO		
	Total area	SURFACE		
	Corroded area	GALVANIC		
	Minimum depth	PITTING		
	Maximum depth	SEVERE		
	Corrosion description	MODERATE		
	Crack description	LIGHT		
	Crack size	NONE		
		CORR_DESC1		
		CORR_DESC2		
		COMMENTS		
		INSPECTOR		
		INSP_DATE		
		MAJOR		
		UPWINGSKIN		
		LGTTOMOD		
		MODTOSEV		
		FATIGUE		
		DOC_REF		
Relationships:	PHOTO_CODE	PHOTO_CODE		
	Section Number		Sect #	

Table 2.6 KC-135 Stratotanker, Work Area Descriptions for PEMCO Depot Facility

KC-135 Stratotanker, Work Area Descriptions for PEM

Work Area	Work Zone	DESCRIPTION
1		Crew Compt(Int)
2		Lwr Fwd Body(Int)
3		Cargo Compt (Int)
4		Cargo Compt(Under Floor)
5		Fwd Body Tank(Int)
6		Lwr Mid Body(Int)
7		C/W Tank Cavity
8		Aft Body Tank Cavity
9		A/R Compt(Int)
10		Upper Deck Tank Cavity
11		Tail Section(Int)
12		Fuselage & A/R Compt(Ext)
13		L Horiz Stab(Ext)
14		R Horiz Stab(Ext)
15		Vert Stab (Ext)
16		L Wing(ext)
17		R Wing(Ext)
18		L F/Well & Cove
19		R F/Well & Cove
20		L MLG & Well
21		R MLG & Well
22		Nose Gear & Well
23		#1 Eng & Strut
24		#2 Eng & Strut
25		#3 Eng & Strut
26		#4 Eng & Strut

Table 2.7 Content Information for the JSOACIS.mdb (E-8C Joint Stars OACIS) Database.

Database File Name:	JSOACIS.mdb	JSOACIS.mdb	JSOACIS.mdb	JSOACIS.mdb
Table Name:	How Mal Codes	J* AIRCRAFT INFO	J*OACIS	OACIS Field Descriptions
Number of Records:	11	6	33442	13
Number of Aircraft		8	8	
Date Range			1/92 - 9/96	
Column Names:	Record	Record	Record	Record
	How Mal Code	AIRCRAFT ID	Work Request Number	OACIS Field Descriptions
	Description	AF #	Date Reported	Field Description
		SERIAL #	Work Unit Code	
		A/C MODEL #	How Mal Code	
		A/C LINE #	Action Taken Code	
		Date of Mfg	When Discovered Code	
		CYCLES	Work Area	
		HOURS	Work Zone	
		STATUS	Discrepancy	
		PRIOR OWNER	Corrective Action	
		USAGE REGION	Tail Number	
		USAGE TYPE		
		NOTES		
Relationships:	How Mal Code		How Mal Code	
		SERIAL #	Tail Number	

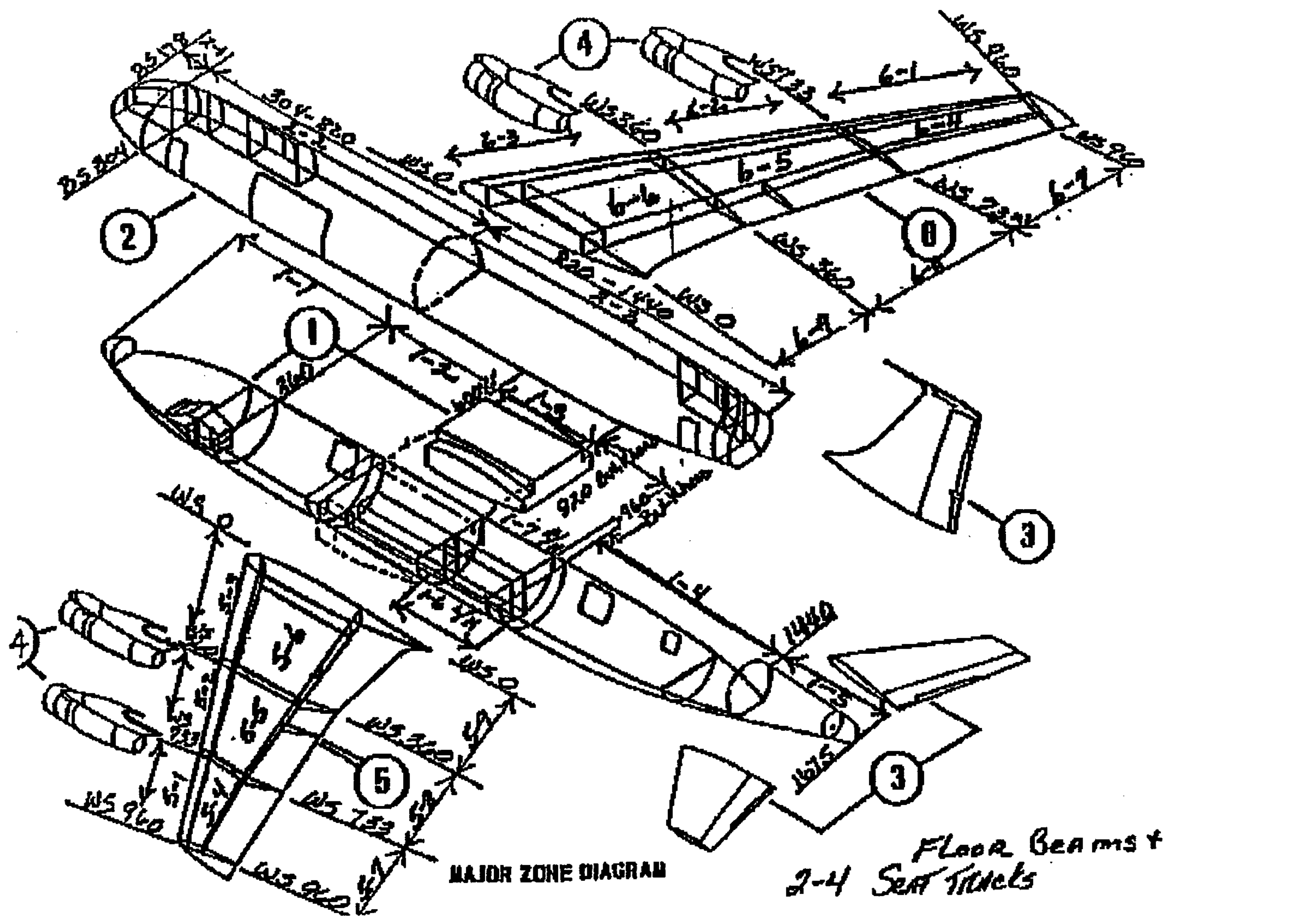


Figure 2.1. Work Zones defined for the E-8C Joint STARS by Northrop-Grumman.

Table 2.8 ACCESS Table of Work Zones (defined by Northrop-Grumman in Figure 2.1) for the E-8C Joint STARS.

Major Zone	Major Zone Primary Description	Major Zone Secondary Description	Station frame range	
1-1	Lower Fuselege structure (below floor) and Tail cone	Nose and Nose Gear support structure	178	360
1-2	Lower Fuselege structure (below floor) and Tail cone	Section forward of wing box up to nose gear support structure	360	600
1-3	Lower Fuselege structure (below floor) and Tail cone	Wing Box	600	820
1-4	Lower Fuselege structure (below floor) and Tail cone	Section Aft of Main Landing Gear to aft pressure bulkhead	960	1440
1-5	Lower Fuselege structure (below floor) and Tail cone	Tail Cone	1440	1675
1-6	Lower Fuselege structure (below floor) and Tail cone	Left main gear support structure	820	960
1-7	Lower Fuselege structure (below floor) and Tail cone	Right main gear support structure	820	960
2-1	Upper Fuseloge structure (above floor)	Cockpit	178	304
2-2	Upper Fuseloge structure (above floor)	Section from cockpit to aft of the wing box	304	820
2-3	Upper Fuseloge structure (above floor)	Section from wing box to aft pressure bulkhead	820	1440
2-4	Floor Beams and Seat Tracks	Floor Beams and Seat Tracks		
3-1	Fin and Horizontal Stabilizer	Left Horizontal Stabilizer		
3-2	Fin and Horizontal Stabilizer	Right Horizontal Stabilizer		
3-3	Fin and Horizontal Stabilizer	Fin		
4-1	Engine Pylon Structure	Left outboard	733	
4-2	Engine Pylon Structure	Left Inboard	360	
4-3	Engine Pylon Structure	Right Outboard	733	
4-4	Engine Pylon Structure	Right Inboard	360	
5-1	Left Wing and Control Surfaces	Outboard wing LE	960	733
5-2	Left Wing and Control Surfaces	Middle wing LE	733	360
5-3	Left Wing and Control Surfaces	Inboard wing LE	360	0
5-4	Left Wing and Control Surfaces	Outboard wing beams and skins	960	733
5-5	Left Wing and Control Surfaces	Middle wing beams and skins	733	360
5-6	Left Wing and Control Surfaces	Inboard wing beams and skins	360	0
5-7	Left Wing and Control Surfaces	Outboard wing TE flaps	960	733
5-8	Left Wing and Control Surfaces	Middle wing TE flaps	733	360
5-9	Left Wing and Control Surfaces	Inboard wing TE flaps	360	0
6-1	Right Wing and Control Surfaces	Outboard wing LE	960	733
6-2	Right Wing and Control Surfaces	Middle wing LE	733	360
6-3	Right Wing and Control Surfaces	Inboard wing LE	360	0
6-4	Right Wing and Control Surfaces	Outboard wing beams and skins	960	733
6-5	Right Wing and Control Surfaces	Middle wing beams and skins	733	360
6-6	Right Wing and Control Surfaces	Inboard wing beams and skins	360	0
6-7	Right Wing and Control Surfaces	Outboard wing TE flaps	960	733
6-8	Right Wing and Control Surfaces	Middle wing TE flaps	733	360
6-9	Right Wing and Control Surfaces	Inboard wing TE flaps	360	0

Table 2.9 Content Information for the JSTARSNG3.mdb (E-8C Joint Stars Northrop-Grumman Over & Above) Database.

Database File Name:	JSTARSNG3.mdb	JSTARSNG3.mdb	JSTARSNG3.mdb	JSTARSNG3.mdb
Table Name:	J*AIRCRAFT INFO	O&A DATA	J* O&A Field Descriptions	J* Zone Loc & Descrip
Number of Records:	6	1536	27	36
Number of Aircraft	2	2		
Date Range	1996	1996		
Column Names:	Record	Record	Record	Record
	AIRCRAFT ID	AIRCRAFT ID	O&A Field Name	Major Zone
	AF #	WORK REQUEST #	O&A Field Description	Major Zone Primary Description
	BOEING A/C SERIAL #	AIRCRAFT ZONE		Major Zone Secondary Description
	A/C MODEL #	ATA/WUC		Loc From:
	A/C LINE #	PART/DOC #		Loc To:
	Date of Mfg	NOMENCLATURE		
	CYCLES	PART SERIAL #		
	HOURS	PRINCIPAL LOADING DIR		
	STATUS	MATERIAL		
	PRIOR OWNER	PART FORM		
	USAGE REGION	H/M		
	USAGE TYPE	DEFECT TYPE		
	NOTES	DEFECT SIZE		
		DEFECT LOCATION		
		DEFECT CAUSE		
		DEFECT ORIENTATION		
		WFD		
		INSPECTION TECHNIQUE		
		PSE		
		DEFECT SEVERITY		
		DEFECT LEVEL		
		WING STATION		
		PLANK NUMBER		
		BODY STATION		
		BUTT LINE		
		WATER LINE		
		VERTICAL STATION		
Relationships:	AIRCRAFT ID	AIRCRAFT ID		
		AIRCRAFT ZONE		Major Zone

Table 2.10 (12 pages) E-8C Joint Stars, Work Area Descriptions for Refurbishment Facility at Lake Charles, LA

* - Indicates a change in the description of the Sub Zone between Weapon Systems.

Zone Work Area	Sub Zone Work Zone		P1-P2 Description	P3-P8 Description	P9 Description	P10 + Description
1-1	1		Skin 1L	Skin 1L	Skin 1L	Skin 1L
	2		Skin 1R	Skin 1R	Skin 1R	Skin 1R
	3		Skin 2L	Skin 2L	Skin 2L	Skin 2L
	4		Skin 2R	Skin 2R	Skin 2R	Skin 2R
	5		Skin 5L	Skin 5L	Skin 5L	Skin 5L
	6		Skin 5R	Skin 5R	Skin 5R	Skin 5R
	7		Skin 6L	Skin 6L	Skin 6L	Skin 6L
	8		Skin 6R	Skin 6R	Skin 6R	Skin 6R
	9		Bulkhead 178	Bulkhead 178	Bulkhead 178	Bulkhead 178
	10		Bulkhead 260	Bulkhead 260	Bulkhead 260	Bulkhead 260
	11		Bulkhead 360	Bulkhead 360	Bulkhead 360	Bulkhead 360
	12		Sub-FloorB/S 178-360	Sub-FloorB/S 178-360	Sub-FloorB/S 178-360	Sub-FloorB/S 178-360
	13		Nose Wheel Well	Nose Wheel Well	Nose Wheel Well	Nose Wheel Well
	14		Doppler Access Floor Panel	Doppler Access Floor Panel	Doppler Access Floor Panel	Doppler Access Floor Panel
	15	*	Misc			
2-1	1		Skin 3L	Skin 3L	Skin 3L	Skin 3L
	2		Skin 3R	Skin 3R	Skin 3R	Skin 3R
	3		Skin 3C	Skin 3C	Skin 3C	Skin 3C
	4		Skin 4L	Skin 4L	Skin 4L	Skin 4L
	5		Skin 4R	Skin 4R	Skin 4R	Skin 4R
	6		Skin 7L	Skin 7L	Skin 7L	Skin 7L
	7		Skin 7R	Skin 7R	Skin 7R	Skin 7R
	8		Skin 8L	Skin 8L	Skin 8L	Skin 8L
	9		Skin 8AL Remvl & Sub Struct	Skin 8AL	Skin 8AL	Skin 8AL
	10		Skin 8R Remvl Sub Struct & Instl	Skin 8R	Skin 8R	Skin 8R
	11		Skin 9L	Skin 9L	Skin 9L	Skin 9L

Table 2.10 (12 pages) E-8C Joint Stars, Work Area Descriptions for Refurbishment Facility at Lake Charles, LA

* - Indicates a change in the description of the Sub Zone between Weapon Systems.

Zone Work Area	Sub Zone Work Zone		P1-P2 Description	P3-P8 Description	P9 Description	P10 + Description
	12		Skin 9R Remvl Sub Struct & Instl	Skin 9R	Skin 9R	Skin 9R
	13		Skin 10C Remvl Sub Struct & Instl	Skin 10C	Skin 10C	Skin 10C
	14		Bulkhead 260	Bulkhead 260	Bulkhead 260	Bulkhead 260
	15		Bulkhead 360	Bulkhead 360	Bulkhead 360	Bulkhead 360
	16		Floor - B/S 178-360	Floor - B/S 178-360	Floor - B/S 178-360	Floor - B/S 178-360
	17	*	Misc		Skin 3CR (Center R/H)	Skin 3CR (Center R/H)
	18	*		Skin 3CL Center L/H		
	19	*		Skin 3CR Center R/H		
1-2	1		Skin 11L	Skin 11L	Skin 11L	Skin 11L
	2		Skin 11R	Skin 11R	Skin 11R	Skin 11R
	3		Skin 12L	Skin 12L	Skin 12L	Skin 12L
	4		Skin 12R	Skin 12R	Skin 12R	Skin 12R
	5		Skin 13L	Skin 13L	Skin 13L	Skin 13L
	6		Skin 13R	Skin 13R	Skin 13R	Skin 13R
	7		Skin 18L	Skin 18L	Skin 18L	Skin 18L
	8		Skin 18R	Skin 18R	Skin 18R	Skin 18R
	9		Skin 19L	Skin 19L	Skin 19L	Skin 19L
	10		Skin 19R	Skin 19R	Skin 19R	Skin 19R
	11		Skin 24R	Skin 24R	Skin 24R	Skin 24R
	12		Cargo Door Frame	Cargo Door Frame	Cargo Door Frame	Cargo Door Frame
	13		Bulkhead 600K	Bulkhead 600K	Bulkhead 600K	Bulkhead 600K
	14		Sub-Floor B/S 360-600K	Sub-Floor B/S 360-600K	Sub-Floor B/S 360-600K	Sub-Floor B/S 360-600K
	15	*	Misc			
2-2	1		Skin 14L	Skin 14L	Skin 14L	Skin 14L
	2		Skin 14R	Skin 14R	Skin 14R	Skin 14R

Table 2.10 (12 pages) E-8C Joint Stars, Work Area Descriptions for Refurbishment Facility at Lake Charles, LA

* - Indicates a change in the description of the Sub Zone between Weapon Systems.

Zone Work Area	Sub Zone Work Zone		P1-P2 Description	P3-P8 Description	P9 Description	P10 + Description
	3		Skin 15L	Skin 15L	Skin 15L	Skin 15L
	4		Skin 15R	Skin 15R	Skin 15R	Skin 15R
	5		Skin 16L	Skin 16L	Skin 16L	Skin 16L
	6		Skin 16R	Skin 16R	Skin 16R	Skin 16R
	7		Skin 17L Remvl Sub Struct & Instl	Skin 17L	Skin 17L	Skin 17L
	8		Skin 17R Remvl Sub Struct & Instl	Skin 17R	Skin 17R	Skin 17R
	9		Skin 20L	Skin 20L	Skin 20L	Skin 20L
	10		Skin 20R	Skin 20R	Skin 20R	Skin 20R
	11		Skin 21L	Skin 21L	Skin 21L	Skin 21L
	12		Skin 21R	Skin 21R	Skin 21R	Skin 21R
	13		Skin 22L	Skin 22L	Skin 22L	Skin 22L
	14		Skin 22R	Skin 22R	Skin 22R	Skin 22R
	15		Skin 23L	Skin 23L	Skin 23L	Skin 23L
	16		Skin 23R	Skin 23R	Skin 23R	Skin 23R
	17		Cargo Door Frame	Cargo Door Frame	Cargo Door Frame	Cargo Door Frame
	18		Bulkhead 600K	Bulkhead 600K	Bulkhead 600K	Bulkhead 600K
	19		Floor B/S 360-600K	Floor B/S 360-600K	Floor B/S 360-600K	Floor B/S 360-600K
	20	*	Misc			
	21	*				Splice to Splice C/T Frame
1-3	1		Center Section Tank Bays	Center Section Tank Bays	Center Section Tank Bays	Center Section Tank Bays
	2		Keel Beams	Keel Beams L and R	Keel Beams L and R	Keel Beams L and R
	3		Sub-Floor B/S 600L-820	Sub-Floor B/S 600L-820	Sub-Floor B/S 600L-820	Sub-Floor B/S 600L-820
	4	*	Misc			
2-3	1		Skin 25L Remvl Only	Skin 25L Remvl Only	Skin 25L Remvl Only	Skin 25L
	2		Skin 25R	Skin 25R	Skin 25R	Skin 25R

Table 2.10 (12 pages) E-8C Joint Stars, Work Area Descriptions for Refurbishment Facility at Lake Charles, LA

* - Indicates a change in the description of the Sub Zone between Weapon Systems.

Zone Work Area	Sub Zone Work Zone		P1-P2 Description	P3-P8 Description	P9 Description	P10 + Description
	3		Skin 26L Remvl Only	Skin 26L Remvl Only	Skin 26L Remvl Only	Skin 26L
	4		Skin 26R Remvl Only	Skin 26R Remvl Only	Skin 26R Remvl Only	Skin 26R
	5		Skin 27L	Skin 27L	Skin 27L	Skin 27L
	6		Skin 27R	Skin 27R	Skin 27R	Skin 27R
	7		Skin 28L	Skin 28L	Skin 28L	Skin 28L
	8		Skin 28R	Skin 28R	Skin 28R	Skin 28R
	9		Skin 29L	Skin 29L	Skin 29L	Skin 29L
	10		Skin 29R	Skin 29R	Skin 29R	Skin 29R
	11		Skin 30L	Skin 30L	Skin 30L	Skin 30L
	12		Skin 30R	Skin 30R	Skin 30R	Skin 30R
	13		Skin 31L	Skin 31L	Skin 31L	Skin 31L
	14		Skin 31R	Skin 31R	Skin 31R	Skin 31R
	15		Bulkhead 820	Bulkhead 820	Bulkhead 820	Bulkhead 820
	16		Bulkhead 960	Bulkhead 960	Bulkhead 960	Bulkhead 960
	17		Floor B/S 600K - 960	Floor Beam Upward B/S 600K - 820 Ctr Wing Area	Floor Beam Upward B/S 600K - 820 Ctr Wing Area	Floor Beam Upward B/S 600K - 820 Ctr Wing Area
	18	*	Misc		Floor Beam B/S 820-960 Wheel Well Area	Floor Beam B/S 820-960 Wheel Well Area
	19	*				Splice to Splice C/T Frame
1-4	1		Skin 32C	Skin 32C	Skin 32C	Skin 32C
	2		Skin 33L	Skin 33L	Skin 33L	Skin 33L
	3		Skin 33R	Skin 33R	Skin 33R	Skin 33R
	4		Skin 34L	Skin 34L	Skin 34L	Skin 34L
	5		Skin 34R	Skin 34R	Skin 34R	Skin 34R
	6		Skin 39C	Skin 39C	Skin 39C	Skin 39C
	7		Skin 40L	Skin 40L	Skin 40L	Skin 40L
	8		Skin 40R	Skin 40R	Skin 40R	Skin 40R
	9		Skin 41L	Skin 41L	Skin 41L	Skin 41L

Table 2.10 (12 pages) E-8C Joint Stars, Work Area Descriptions for Refurbishment Facility at Lake Charles, LA

* - Indicates a change in the description of the Sub Zone between Weapon Systems.

Zone	Sub Zone		P1-P2	P3-P8	P9	P10 +
Work Area	Work Zone		Description	Description	Description	Description
	10		Skin 41R	Skin 41R	Skin 41R	Skin 41R
	11		Skin 43C	Skin 43C	Skin 43C	Skin 43C
	12		Skin 44L	Skin 44L	Skin 44L	Skin 44L
	13		Skin 44R	Skin 44R	Skin 44R	Skin 44R
	14		Skin 45L	Skin 45L	Skin 45L	Skin 45L
	15		Skin 45R	Skin 45R	Skin 45R	Skin 45R
	16		Skin 47R	Skin 47R	Skin 47R	Skin 47R
	17		Skin 48L	Skin 48L	Skin 48L	Skin 48L
	18		Skin 48R	Skin 48R	Skin 48R	Skin 48R
	19		Skin 53L	Skin 53L	Skin 53L	Skin 53L
	20		Skin 53R	Skin 53R	Skin 53R	Skin 53R
	21	*	Fwd Cargo Door Frame	Fwd Cargo Door Frame	Center Cargo Door Frame	Center Cargo Door Frame
	22		Aft Cargo Door Frame	Aft Cargo Door Frame	Aft Cargo Door Frame	Aft Cargo Door Frame
	23		Bulkhead 1240	Bulkhead 1240	Bulkhead 1240	Bulkhead 1240
	24		Bulkhead 1360	Bulkhead 1360	Bulkhead 1360	Bulkhead 1360
	25		Sub-Floor B/S 960-1440	Sub-Floor B/S 960-1440	Sub-Floor B/S 960-1440	Sub-Floor B/S 960-1440
	26	*	Misc		Seat Track, C & Z Channels & Gusset	Seat Track, C & Z Channels & Gusset
2-4	1		Skin 35L	Skin 35L	Skin 35L	Skin 35L
	2		Skin 35R	Skin 35R	Skin 35R	Skin 35R
	3		Skin 36L	Skin 36L	Skin 36L	Skin 36L
	4		Skin 36R	Skin 36R	Skin 36R	Skin 36R
	5		Skin 37L	Skin 37L	Skin 37L	Skin 37L
	6		Skin 37R	Skin 37R	Skin 37R	Skin 37R
	7		Skin 38L	Skin 38L	Skin 38L	Skin 38L
	8		Skin 38R	Skin 38R	Skin 38R	Skin 38R
	9		Skin 42L	Skin 42L	Skin 42L	Skin 42L
	10		Skin 42R	Skin 42R	Skin 42R	Skin 42R

Table 2.10 (12 pages) E-8C Joint Stars, Work Area Descriptions for Refurbishment Facility at Lake Charles, LA

* - Indicates a change in the description of the Sub Zone between Weapon Systems.

Zone Work Area	Sub Zone Work Zone		P1-P2 Description	P3-P8 Description	P9 Description	P10 + Description
	11		Skin 46L Remvl Only	Skin 46L	Skin 46L	Skin 46L
	12		Skin 46R	Skin 46R	Skin 46R	Skin 46R
	13		Skin 49L Remvl & Sub Struct	Skin 49L	Skin 49L	Skin 49L
	14		Skin 49R Remvl Only	Skin 49R	Skin 49R	Skin 49R
	15		Skin 50L	Skin 50L	Skin 50L	Skin 50L
	16		Skin 50R	Skin 50R	Skin 50R	Skin 50R
	17		Skin 51L	Skin 51L	Skin 51L	Skin 51L
	18		Skin 51R	Skin 51R	Skin 51R	Skin 51R
	19		Skin 52L	Skin 52L	Skin 52L	Skin 52L
	20		Skin 52R	Skin 52R	Skin 52R	Skin 52R
	21		Skin 54L Remvl	Skin 54L	Skin 54L	Skin 54L
	22		Skin 54R Remvl	Skin 54R	Skin 54R	Skin 54R
	23		Skin 55L Remvl	Skin 55L	Skin 55L	Skin 55L
	24		Skin 55R	Skin 55R	Skin 55R	Skin 55R
	25	*	Skin 56L	Skin 56L	Skin 56R	Skin 56R
	26	*	Skin 56R	Skin 56R	Bulkhead 1240	Bulkhead 1240
	27	*	Skin 57L	Skin 57L	Bulkhead 1360	Bulkhead 1360
	28	*	Skin 57R	Skin 57R	Floor B/S 960-1440	
	29	*	Bulkhead 1240	Bulkhead 1240		
	30	*	Bulkhead 1360	Bulkhead 1360		
	31	*	Floor B/S 960-1440	Floor B/S 960-1440		Floor Beams/Floor B/S 960-1440
	32	*	Misc			
	33	*				Splice to Splice C/T Frame
2-5	1		Skin 58C	Skin 58C	Skin 58C	Skin 58C
	2		Skin 59L	Skin 59L	Skin 59L	Skin 59L
	3		Skin 59R	Skin 59R	Skin 59R	Skin 59R
	4		Skin 60L	Skin 60L	Skin 60L	Skin 60L

Table 2.10 (12 pages) E-8C Joint Stars, Work Area Descriptions for Refurbishment Facility at Lake Charles, LA

* - Indicates a change in the description of the Sub Zone between Weapon Systems.

Zone	Sub Zone		P1-P2	P3-P8	P9	P10 +
Work Area	Work Zone		Description	Description	Description	Description
	5		Skin 60R	Skin 60R	Skin 60R	Skin 60R
	6		Skin 61L	Skin 61L	Skin 61L	Skin 61L
	7		Skin 61R	Skin 61R	Skin 61R	Skin 61R
	8		Skin 62C	Skin 62C	Skin 62C	Skin 62C
	9		Skin 63L	Skin 63L	Skin 63L	Skin 63L
	10		Skin 63R	Skin 63R	Skin 63R	Skin 63R
	11		Skin 64L	Skin 64L	Skin 64L	Skin 64L
	12		Skin 64R	Skin 64R	Skin 64R	Skin 64R
	13		Skin 65L	Skin 65L	Skin 65L	Skin 65L
	14		Skin 65R	Skin 65R	Skin 65R	Skin 65R
	15	*		Skin 65C	Skin 65C	Skin 65C
	16		Skin 66C	Skin 66C	Skin 66C	Skin 66C
	17	*	Skin 67C	Skin 67C	Skin 67L	Skin 67L
	18	*	SKin 68L	SKin 68L	Skin 67R	Skin 67R
	19	*	Skin 68R	Skin 68R	SKin 68L	SKin 68L
	20	*	Skin 69C	Skin 69C	Skin 68R	Skin 68R
	21	*		Skin 70C	Skin 70C	Skin 70C
	22	*	Bulkhead 1440	Bulkhead 1440	Skin 69C	Skin 69C
	23	*	Floor - Aft of B/S 1440	Floor - Aft of B/S 1440	Bulkhead 1440	Bulkhead 1440
	24	*	Misc		Floor - Aft of B/S 1440	Floor - Aft of B/S 1440
1-6	1	*	Center Area B/S 820-860	Center Area B/S 860-960 W/L 136-203	Center Area B/S 860-960 W/L 136-203	Center Area B/S 860-960 W/L 136-203
	2	*	Center Web B/S 860-960	Center Web B/S 860-960	Water tank wall L Keel Beam (B/S 860-960)	Water tank wall L Keel Beam (B/S 860-960)
	3		Bulkhead 820	Bulkhead 820	Bulkhead 820	Bulkhead 820
	4		Bulkhead 960	Bulkhead 960	Bulkhead 960	Bulkhead 960
	5	*	Sub-Floor B/S 820-960	Sub-Floor B/S 820-960	Overhead Press Web B/S 820-960	Overhead Press Web B/S 820-960

Table 2.10 (12 pages) E-8C Joint Stars, Work Area Descriptions for Refurbishment Facility at Lake Charles, LA

* - Indicates a change in the description of the Sub Zone between Weapon Systems.

Zone Work Area	Sub Zone Work Zone		P1-P2 Description	P3-P8 Description	P9 Description	P10 + Description
1-7	1	*	Keel Beams	Keel Beams	Center Area B/S 860-960/W/L 136-203	Center Area B/S 860-960/W/L 136-203
	2	*	Center Web B/S 860-960	Center Web B/S 860-960	Water Tank Wall R Keel Beam B/S 860-960	Water Tank Wall R Keel Beam B/S 860-960
	3		Bulkhead 820	Bulkhead 820	Bulkhead 820	Bulkhead 820
	4		Blkhead 960	Blkhead 960	Blkhead 960	Blkhead 960
	5	*	Sub_Floor B/S 820-960	Sub_Floor B/S 820-960	Overhead Press Web B/S 820-960	Overhead Press Web B/S 820-960
3-1	1	*	L/H Horizontal Stabilizer	L/H Horizontal Stabilizer	L/H Horizontal Stabilizer	
3-2	1	*	R/H Horizontal Stabilizer	R/H Horizontal Stabilizer	R/H Horizontal Stabilizer	
3-3	1	*	Vertical Stabilizer	Vertical Stabilizer	Vertical Stabilizer	
4-1	1		O/B L/H Pylon	O/B L/H Pylon	O/B L/H Pylon	O/B L/H Pylon
4-2	1		I/B L/H Pylon	I/B L/H Pylon	I/B L/H Pylon	I/B L/H Pylon
4-3	1		I/B R/H Pylon	I/B R/H Pylon	I/B R/H Pylon	I/B R/H Pylon
4-4	1		O/B R/H Pylon	O/B R/H Pylon	O/B R/H Pylon	O/B R/H Pylon
5-0	1	*		L/H Wing (P3 - P6)	L/H Wing	L/H Wing
				820 Fitting (P3-P6)	820 Fitting	820 Fitting
5-1	1		L/H Wing L/E O/B	L/H Wing L/E O/B	L/H Wing L/E O/B	L/H Wing L/E O/B

Table 2.10 (12 pages) E-8C Joint Stars, Work Area Descriptions for Refurbishment Facility at Lake Charles, LA

* - Indicates a change in the description of the Sub Zone between Weapon Systems.

Zone Work Area	Sub Zone Work Zone		P1-P2 Description	P3-P8 Description	P9 Description	P10 + Description
5-2	1		L/H Upper Ctr Spar Chord	L/H Upper Ctr Spar Chord	L/H Upper Ctr Spar Chord	L/H Upper Ctr Spar Chord
	2		L/H Lower Ctr Spar Chord	L/H Lower Ctr Spar Chord	L/H Lower Ctr Spar Chord	L/H Lower Ctr Spar Chord
	3	*	Misc	Leading Edge Web & Stiffeners	Leading Edge Web & Stiffeners	Leading Edge Web & Stiffeners
	4	*		733 Production Break	733 Production Break	733 Production Break
5-3	1		L/H Upper Inbd Spar Chord	L/H Upper Inbd Spar Chord	L/H Upper Inbd Spar Chord	L/H Upper Inbd Spar Chord
	2		L/H Lower Inbd Spar Chord	L/H Lower Inbd Spar Chord	L/H Lower Inbd Spar Chord	L/H Lower Inbd Spar Chord
	3	*	Misc	Leading Edge Web & Stiffeners	Leading Edge Web & Stiffeners	Leading Edge Web & Stiffeners
5-4	1		L/H Wing tank O/B	L/H Wing tank O/B	L/H Wing tank O/B	L/H Wing tank O/B
5-5	1		L/H #1 Main Tank	L/H #1 Main Tank	L/H #1 Main Tank	L/H #1 Main Tank
	2		L/H #2 Main Tank	L/H #2 Main Tank	L/H #2 Main Tank	L/H #2 Main Tank
	3		L/H Inboard Main Tank	L/H Inboard Main Tank	L/H Inboard Main Tank	L/H Inboard Main Tank
	4	*		Upper 360 Doubler (P3-P6)	L/H Upper 360 Doubler	L/H Upper 360 Doubler
	5	*		Lower 360 Doubler(P3-P6)	L/H Lower 360 Doubler	L/H Lower 360 Doubler
5-6	1		L/H Upper Plank #1	L/H Upper Plank #1	L/H Upper Plank #1	L/H Upper Plank #1
	2		L/H Upper Plank #2	L/H Upper Plank #2	L/H Upper Plank #2	L/H Upper Plank #2
	3		L/H Upper Plank #3	L/H Upper Plank #3	L/H Upper Plank #3	L/H Upper Plank #3
	4		L/H Upper Plank #4	L/H Upper Plank #4	L/H Upper Plank #4	L/H Upper Plank #4
	5		L/H Upper Plank #5	L/H Upper Plank #5	L/H Upper Plank #5	L/H Upper Plank #5
	6		L/H Upper Plank #6	L/H Upper Plank #6	L/H Upper Plank #6	L/H Upper Plank #6
	7		L/H Lower Plank #1	L/H Lower Plank #1	L/H Lower Plank #1	L/H Lower Plank #1
	8		L/H Lower Plank #2	L/H Lower Plank #2	L/H Lower Plank #2	L/H Lower Plank #2
	9		L/H Lower Plank #3	L/H Lower Plank #3	L/H Lower Plank #3	L/H Lower Plank #3
	10		L/H Lower Plank #4	L/H Lower Plank #4	L/H Lower Plank #4	L/H Lower Plank #4

Table 2.10 (12 pages) E-8C Joint Stars, Work Area Descriptions for Refurbishment Facility at Lake Charles, LA

* - Indicates a change in the description of the Sub Zone between Weapon Systems.

Zone Work Area	Sub Zone Work Zone		P1-P2 Description	P3-P8 Description	P9 Description	P10 + Description
	11		L/H Lower Plank #5	L/H Lower Plank #5	L/H Lower Plank #5	L/H Lower Plank #5
	12		L/H Lower Plank #6	L/H Lower Plank #6	L/H Lower Plank #6	L/H Lower Plank #6
	13		L/H Lower Plank #7	L/H Lower Plank #7	L/H Lower Plank #7	L/H Lower Plank #7
	14		L/H Lower Plank #8	L/H Lower Plank #8	L/H Lower Plank #8	L/H Lower Plank #8
	15		L/H Lower Plank #9	L/H Lower Plank #9	L/H Lower Plank #9	L/H Lower Plank #9
	16	*		L/H Upper Beaver Tail	L/H Upper Beaver Tail	L/H Upper Beaver Tail
	17	*		L/H Lower Beaver Tail	L/H Lower Beaver Tail	L/H Lower Beaver Tail
	18	*		L/H Lower Splice Plates	L/H Lower Splice Plates	L/H Lower Splice Plates
5-7	1		L/H Wing T/E O/B	L/H Wing T/E O/B	L/H Wing T/E O/B	L/H Wing T/E O/B
5-8	1		L/H Upper Ctr Spar Chord	L/H Upper Ctr Spar Chord	L/H Upper Ctr Spar Chord	L/H Upper Ctr Spar Chord
	2		L/H Lower Ctr Spar Chord	L/H Lower Ctr Spar Chord	L/H Lower Ctr Spar Chord	L/H Lower Ctr Spar Chord
	3	*	Misc	Trailing Edge Web	Trailing Edge Web	Trailing Edge Web
5-9	1		L/H Upper Inbd Spar Chord	L/H Upper Inbd Spar Chord	L/H Upper Inbd Spar Chord	L/H Upper Inbd Spar Chord
	2		L/H Lower Inbd Spar Chord	L/H Lower Inbd Spar Chord	L/H Lower Inbd Spar Chord	L/H Lower Inbd Spar Chord
	3	*	Misc	Trailing Edge Web	Trailing Edge Web	Trailing Edge Web
	4	*		Fillet Flap	Fillet Flap	Fillet Flap
	5	*			L/H Follow Up Door Area W5.0 - 5.59	L/H Follow Up Door Area W5.0 - 5.59
6-0	1			R/H Wing(P3-P6)	R/H Wing	R/H Wing
	2			820 Fitting(P3-P6)	820 Fitting	820 Fitting
6-1	1		R/H Wing L/E O/B	R/H Wing L/E O/B	R/H Wing L/E O/B	R/H Wing L/E O/B
6-2	1		R/H Upper Ctr Spar Chord	R/H Upper Ctr Spar Chord	R/H Upper Ctr Spar Chord	R/H Upper Ctr Spar Chord
	2		R/H Lower Ctr Spar Chord	R/H Lower Ctr Spar Chord	R/H Lower Ctr Spar Chord	R/H Lower Ctr Spar Chord

Table 2.10 (12 pages) E-8C Joint Stars, Work Area Descriptions for Refurbishment Facility at Lake Charles, LA

* - Indicates a change in the description of the Sub Zone between Weapon Systems.

Zone	Sub Zone		P1-P2	P3-P8	P9	P10 +
Work Area	Work Zone		Description	Description	Description	Description
	3	*	Misc	Leading Edge Web	Leading Edge Web	Leading Edge Web
	4	*		733 Production Break	733 Production Break	733 Production Break
6-3	1		R/H Upper Inbd Spar Chord	R/H Upper Inbd Spar Chord	R/H Upper Inbd Spar Chord	R/H Upper Inbd Spar Chord
	2		R/H Lower Inbd Spar Chord	R/H Lower Inbd Spar Chord	R/H Lower Inbd Spar Chord	R/H Lower Inbd Spar Chord
	3	*	Misc	Leading Edge Web	Leading Edge Web	Leading Edge Web
6-4	1		R/H Wing Tank O/B	R/H Wing Tank O/B	R/H Wing Tank O/B	R/H Wing Tank O/B
6-5	1		R/H #3 Main Tank	R/H #3 Main Tank	R/H #3 Main Tank	R/H #3 Main Tank
	2		R/H #4 Main Tank	R/H #4 Main Tank	R/H #4 Main Tank	R/H #4 Main Tank
	3		R/H Inboard Main Tank	R/H Inboard Main Tank	R/H Inboard Main Tank	R/H Inboard Main Tank
	4	*		Upper 360 Doubler(P3-P6)	R/H Upper 360 Doubler	R/H Upper 360 Doubler
	5	*		Lower 360 Doubler(P3-P6)	R/H Lower 360 Doubler	R/H Lower 360 Doubler
6-6	1		R/H Upper Plank #1	R/H Upper Plank #1	R/H Upper Plank #1	R/H Upper Plank #1
	2		R/H Upper Plank #2	R/H Upper Plank #2	R/H Upper Plank #2	R/H Upper Plank #2
	3		R/H Upper Plank #3	R/H Upper Plank #3	R/H Upper Plank #3	R/H Upper Plank #3
	4		R/H Upper Plank #4	R/H Upper Plank #4	R/H Upper Plank #4	R/H Upper Plank #4
	5		R/H Upper Plank #5	R/H Upper Plank #5	R/H Upper Plank #5	R/H Upper Plank #5
	6		R/H Upper Plank #6	R/H Upper Plank #6	R/H Upper Plank #6	R/H Upper Plank #6
	7		R/H Lower Plank #1	R/H Lower Plank #1	R/H Lower Plank #1	R/H Lower Plank #1
	8		R/H Lower Plank #2	R/H Lower Plank #2	R/H Lower Plank #2	R/H Lower Plank #2
	9		R/H Lower Plank #3	R/H Lower Plank #3	R/H Lower Plank #3	R/H Lower Plank #3
	10		R/H Lower Plank #4	R/H Lower Plank #4	R/H Lower Plank #4	R/H Lower Plank #4
	11		R/H Lower Plank #5	R/H Lower Plank #5	R/H Lower Plank #5	R/H Lower Plank #5
	12		R/H Lower Plank #6	R/H Lower Plank #6	R/H Lower Plank #6	R/H Lower Plank #6
	13		R/H Lower Plank #7	R/H Lower Plank #7	R/H Lower Plank #7	R/H Lower Plank #7
	14		R/H Lower Plank #8	R/H Lower Plank #8	R/H Lower Plank #8	R/H Lower Plank #8

Table 2.10 (12 pages) E-8C Joint Stars, Work Area Descriptions for Refurbishment Facility at Lake Charles, LA

* - Indicates a change in the description of the Sub Zone between Weapon Systems.

Zone Work Area	Sub Zone Work Zone		P1-P2 Description	P3-P8 Description	P9 Description	P10 + Description
	15		R/H Lower Plank #9	R/H Lower Plank #9	R/H Lower Plank #9	R/H Lower Plank #9
	16	*		R/H Upper Beaver Tail	R/H Upper Beaver Tail	R/H Upper Beaver Tail
	17	*		R/H Lower Beaver Tail	R/H Lower Beaver Tail	R/H Lower Beaver Tail
	18	*		R/H Lower Splice Plates	R/H Lower Splice Plates	R/H Lower Splice Plates
6-7	1		R/H Wing T/E O/B	R/H Wing T/E O/B	R/H Wing T/E O/B	R/H Wing T/E O/B
6-8	1		R/H Upper Ctr Spar Chord	R/H Upper Ctr Spar Chord	R/H Upper Ctr Spar Chord	R/H Upper Ctr Spar Chord
	2		R/H Lower Ctr Spar Chord	R/H Lower Ctr Spar Chord	R/H Lower Ctr Spar Chord	R/H Lower Ctr Spar Chord
	3	*	Misc	Trailing Edge Web	Trailing Edge Web	Trailing Edge Web
6-9	1		R/H Upper Inbd Spar Chord	R/H Upper Inbd Spar Chord	R/H Upper Inbd Spar Chord	R/H Upper Inbd Spar Chord
	2		R/H Lower Inbd Spar Chord	R/H Lower Inbd Spar Chord	R/H Lower Inbd Spar Chord	R/H Lower Inbd Spar Chord
	3	*	Misc	Trailing Edge Web	Trailing Edge Web	Trailing Edge Web
	4	*		Fillet Flap	Fillet Flap	Fillet Flap
	5	*			R/H Follow Up Door Area W5.0-5.59	R/H Follow Up Door Area W5.0-5.59
8-0			Service Bulletins	Service Bulletins	Service Bulletins	Service Bulletins
				Electrical O/As	Electrical O/As	Electrical O/As
				Material Only O/As	Material Only O/As	Material Only O/As
				Systems O/As	Systems O/As	Systems O/As
9-7			Both Wings	Both Wings	Both Wings(Sys Sta 1-3)	Both Wings(Sys Sta 1-3)
9-8			Whole Fuselage	Whole Fuselage(Sys Sta 1-3)	Whole Fuselage(Sys Sta 1-3)	Whole Fuselage
9-9			Whole Aircraft	Whole Aircraft(Sys Sta 1-3)	Whole Aircraft(Sys Sta 1-3)	Whole Aircraft

Table 2.11 Content Information for the C9OACIS.mdb (C-9A/C Nightingale OACIS) Database.

Database File Name:	C9OACIS.mdb	C9OACIS.mdb	C9OACIS.mdb
Table Name:	C9 OACIS	How Mal Codes	OACIS Field Descriptions
Number of Records:	12950	11	13
Number of Aircraft	61		
Date Range	8/90 - 8/96		
Column Names:	Record	Record	Record
	Work Request Number	How Mal Code	OACIS Field
	Date Reported	Description	Field Description
	Work Unit Code		
	How Mal Code		
	Action Taken Code		
	When Discovered Code		
	Work Area		
	Work Zone		
	Discrepancy		
	Corrective Action		
	Tail Number		
Relationships:	How Mal Code	How Mal Code	

Table 2.12 (2 pages) C-9A/C Nightingale, Work Area Descriptions for LACI Depot Facility.

Work Area	Work Zone	DESCRIPTION
1	0	Ext Surfaces of Wing (Both Sides)
	1	LH Wing LE & Tip
	2	RH Wing LE & Tip
	3	LH inter-Spar Box (LH Fuel Tank & Vent Box)
	4	RH inter-Spar Box RH Fuel Tank & Vent Box)
	5	LH TE Structure and Control Surfaces Aft of Rear Spar
	6	RH TE Structure and Control Surfaces Aft of Rear Spar
	7	LH Main Landing Gear and Strut Door
	8	RH Main Landing Gear and Strut Door
2	0	Ext Surfaces of Wing/Fuselage Fillets
	1	LH Wing/Fuselage Fillet (includes Upper & Lower Wing Skins & Fuselage Skin Covered by Fillet)
	2	RH Wing/Fuselage Fillet (includes Upper & Lower Wing Skins & Fuselage Skin Covered by Fillet)
	3	Wing Center Section (Front to Rear Spar & Sta LH to 58RH)
3	0	Ext Surfaces of Horiz Empennage
	1	LH Horiz Stab LE & tip
	2	RH Horiz Stab LE & tip
	3	LH outboard Stab Inter-Spar Box
	4	RH outboard Stab Inter-Spar Box
	5	LH Elev, Tabs, TE Structure Aft of Rear Spar
	6	RH Elev, Tabs, TE Structure Aft of Rear Spar
	7	LH Horiz to Vert Stab Fairing Plates
	8	RH Horiz to Vert Stab Fairing Plates
	9	Horiz Stab Center Section Box
4	0	Ext Surfaces of Fuselage from Sta 7 - 229
	1	Radome(All unpressurized area of fuselage fwd of Sta 37)
	2	All pressurized area from Sta 37 - 69 above pressure panel
	3	Nose Wheel Well, Doors & Tunnels (Unpressurized area from Sta 37 - 110 below pressure panel
	4	All pressurized, from Sta 69 - 160 above the floor
	5	All pressurezed, from Sta 69 - 229 below the floor(radio/elec compt)
	6	All pressurized area from Sta 160 - 229 above the floor
	7	Nose landing gear assembly
5	0	Ext surfaces of fuselage from Sta 229 - 1087
	1	Fwd cargo compt(All pressurized area from Sta 229 - 606 below cabin floor)
	2	Not Used
	3	All pressurized area below floor and above wing center section & wheel well pressure panel (Sta 606 - 760)
	4	All unpressurized area below wing center section from front to rear spar (Sta 606 - 691)
	5	Fixed structure of LH TE W/W and W/W door
	6	Fixed structure of RH TE W/W and W/W door

Table 2.12 (2 pages) C-9A/C Nightingale, Work Area Descriptions for LACI Depot Facility.

Work Area	Work Zone	DESCRIPTION
	7	Aft cargo Compt
	8	Cabin & Lavatory Area
	9	All unpressurized area of fuselage from Sta 996 - 1087(manuf splice)
6	0	Ext Surface of Aft fuselage & vert empennage
	1	All unpressurized area of the fuselage from Sta 1087 - 1291
	2	Not Used
	3	Vert Stab LE and Tip Fairing
	4	Vert Stab Inter-Spar Box
	5	Rudder, Tabs & TE structure of vert stab aft of the rear spar
7	0	Ext surfaces of nacelles
	1	LH Demountable power plant
	2	RH Demountable power plant
	3	LH Engine Nose Cowl & Bullet
	4	RH Engine Nose Cowl & Bullet
	5	LH Reverser & Tail Pipe Assy
	6	RH Reverser & Tail Pipe Assy
	7	LH Upper & Lower Nacelle Doors
	8	RH Upper & Lower Nacelle Doors
8	0	Ext Surfaces of Aprons & Pylons
	1	LH Engine Pylon & Apron
	2	RH Engine Pylon & Apron

Table 2.13 Content Information for the C130ARINC (C-130 Hercules) Database

Database File Name:	C130Arincdb.mdb	C130Arindb.mdb	C130Arincdb.mdb	C130Arincdb.mdb	C130Arincdb.mdb
Table Name:	Critical Component Data	MDS	NDI Method	WUC Descriptions	WUC vs DADTA Point
Number of Records:	241	3	8	875	451
Number of Aircraft					
Date Range					
Column Names:	Record ID	MDS ID	Method ID	Record ID	WUC
	MDS	MDS	NDI Method	WUC	Applicable DADTA Point
	DADTA Analysis Point	Note	NDI Abbreviation	Major Section	
	Major Aircraft Section	Economic Life		Section	
	Station Reference			Description	
	Description			Potential IATP Point	
	Critical Element			Applicable DADTA Point	
	Initial Flaw Size				
	Initial Flaw Shape				
	Critical Crack Length				
	Design Limit Stress				
	Safety Limit				
	Maximum Undetectable Flaw Size				
	Maximum Undetectable Flaw Size2				
	NDI Method				
	NDI Method2				
	Primary NDI 1				
	Primary NDI 2				
	Backup NDI				
	Initial Inspection				
	Recurring Inspection				
	Material				
	Conversion Coating				
	Primer Coat				
	Topcoat				
	Environment				
	IAT Tracked				
Relationships:	DADTA Analysis Point				Applicable DADTA Point
				WUC	WUC

Table 2.14 Content Information for the C130OACIS.mdb (C-130 Hercules) Database

Database File Name:	C130OACIS.mdb	C130OACIS.mdb	C130OACIS.mdb	C130OACIS.mdb	C130OACIS.mdb	C130OACIS.mdb
Table Name:	Critical Component Data	How Mal Codes	OACIS	OACIS Field Descriptions	WUC Descriptions	WUC vs DADTA Point
Number of Records:	241	11	8065	13	875	451
Number of Aircraft			101			
Date Range						
Column Names:	Record ID	Record	Record	Record	WUC ID	WUC
	MDS	How Mal Code	Contract Number	OACIS Field	WUC	Applicable DADTA Point
	DADTA Analysis Point	Description	A/C Serial #	Field Description	Major Section	
	Major Aircraft Section		Work Req #		Section	
	Station Reference		Work Req Date		Description	
	Description		Work Unit Code		Potential IATP Point	
	Critical Element		How Mal Code		Applicable DADTA Point	
	Initial Flaw Size		Action Taken Code			
	Initial Flaw Shape		When Discovered Code			
	Critical Crack Length		Work Area			
	Design Limit Stress		Work Zone			
	Safety Limit		Discrepancy			
	Maximum Undetectable Flaw Size		Corrective Action			
	Maximum Undetectable Flaw Size2					
	NDI Method					
	NDI Method2					
	Primary NDI 1					
	Primary NDI 2					
	Backup NDI					
	Initial Inspection					
	Recurring Inspection					
	Material					
	Conversion Coating					
	Primer Coat					
	Topcoat					
	Environment					
	IAT Tracked					
Relationships:	DADTA Analysis Point					Applicable DADTA Point
			Work Unit Code		WUC	WUC

Table 2.15 Content Information for the C130AFMC202.mdb (C-130 Hercules) Database

Database File Name:	C130AFMC202.mdb	C130AFMC202.mdb	C130AFMC202.mdb	C130AFMC202.mdb	C130AFMC202.mdb	C130AFMC202.mdb	C130AFMC202.mdb
Table Name:	202 Data	202 Field Descriptuons	Damage Classification	Engineers	Locations	Planners	Solutions
Number of Records:	1003	14	31	27	50	54	4
Number of Aircraft	127						
Date Range							
Column Names:	Date	ID	Damage Classification	LastName	Location on Aircraft	Lastname	Solution
	Control Number	Field Name	Description	FirstName	Description	First Name	
	Noun	Field Description		Office Symbol		Phone	
	NSN			Phone		Office	
	Part Number			E-Mail			
	Additional Applicable Drawings or Notes:						
	Serial/Tail Number						
	Planner						
	Deficiency						
	Location on Aircraft						
	Solution						
	Damage Classification						
	Engineer						
Relationships:	Planner					Lastname	
	Location on Aircraft				Location on Aircraft		
	Damage Classification		Damage Classification				
	Engineer			Lastname			

Table 2.16 Content Information for the C130AIRS.mdb (C-130 Hercules) Database

Database File Name:	C130Airs.mdb	C130Airs.mdb	C130Airs.mdb
Table Name:	C130 AIRS	Airs Field Discriptions	How Mal Codes
Number of Records:	3769	27	3
Number of Aircraft	116		
Date Range			
Column Names:	Record	ID	ID
	Serial #	Field Name	H/M Code
	MDS	Field Discription	Corrosion Severity
	Date		
	Flight Hours		
	Inspection Facility		
	Inspection Type		
	TCTO Number		
	Disposition		
	Type of Damage		
	Position 1		
	Position 2		
	Position 3		
	Zone		
	Row		
	Column		
	Water Line		
	Fuselage Station		
	Butt Line		
	Index		
	Corrosion Severity		
	Depth		
	Area/Length		
	Repair Limit		
	FSCM		
	Repair Reference		
	Part 1		
	Part 2		
	Part 3		
	Part 4		
	Component Serial #		
	MDR		
	Material Cost		
	Labor Cost		
Relationships:	Corrosion Severity		Corrosion Severity

Table 2.17 Content Information for the C130REMIS.mdb (C-130 Hercules) Database

Database File Name:	C130REMIS.mdb	C130REMIS.mdb	C130REMIS.mdb	C130REMIS.mdb	C130REMIS.mdb	C130REMIS.mdb
Table Name:	Critical Component Data	GeoLoc Codes	REMIS	REMIS Field Descriptions	WUC Descriptions	WUC vs DADTA Point
Number of Records:	241	46	2922	8	875	451
Number of Aircraft		447	447			
Date Range						
Column Names:	Record ID	GeoLoc ID	Record	ID	WUC ID	WUC
	MDS	GeoLoc Code	MDS	Field1	WUC	Applicable DADTA Point
	DADTA Analysis Point	Location Name	GEOGRAPHIC LOCATION	Field2	Major Section	
	Major Aircraft Section	State or Country	A/C SERIAL NUMBER		Section	
	Station Reference		WORK UNIT CODE		Description	
	Description		CORROSION OCCURENCES		Potential IATP Point	
	Critical Element		REPAIR MANHOURS		Applicable DADTA Point	
	Initial Flaw Size		MTBC			
	Initial Flaw Shape					
	Critical Crack Length					
	Design Limit Stress					
	Safefy Limit					
	Maximum Undetectable Flaw Size					
	Maximum Undetectable Flaw Size2					
	NDI Method					
	NDI Method2					
	Primary NDI 1					
	Primary NDI 2					
	Backup NDI					
	Initial Inspection					
	Recurring Inspection					
	Material					
	Conversion Coating					
	Primer Coat					
	Topcoat					
	Environment					
	IAT Tracked					
Relationships:	DADTA Analysis Point					Applicable DADTA Point
			WORK UNIT CODE		WUC	WUC

Table 2.18 C-130 Hercules, Work Area Descriptions for PEMCO Depot Facility

C-130 Hercules, Work Area Descriptions for PEMCO Depot Facility

Work Area	Work Zone	DESCRIPTION
1		Nose Section Radome tip to Sta 245
2		Fuselage section Sta 245 - 737
3		Aft Fuselage Sta 737 - 1041 & Empennage
4		Top of R Wing
5		Top of L Wing
6		Bottom of R Wing
7		Bottom of L Wing
8		Nose Gear & Wheel Well
9		R Main Gear & Wheel Well
10		L Main Gear & Wheel Well
11		Flight deck & Equip Area
12		Fwd cargo compt Sta 245 - 477
13		Center cargo compt Sta 477 - 737
14		Aft cargo compt Sta 737 - 1041
15		No 1 engine & propeller
16		No 2 engine & propeller
17		No 3 engine & Propeller
18		No 4 Engine & Propeller
19		Center wing section

Table 2.19 (2 pages) C-5A Galaxy, ACCESS Table of DTA Points (Reference [24]).

ID	Airframe Section	Ref. [24] Section #	DTA ID #	Description	WS	FS	BL	WL	Component	Crack Configuration
1	Center Wing	2.1.1a	1c	Ws 120 Splice at FS 1303 Lower Surface	120	1303			Panel Tab	Single Edge Thru
2	Center Wing	2.1.1b	1c	Ws 120 Splice at FS 1303 Lower Surface	120	1303			Panel Tab	Single Edge Thru, ECP6512
3	Center Wing	2.1.1c	1c	Ws 120 Splice at FS 1303 Lower Surface	120	1303			Panel Tab	Double Edge Thru
4	Center Wing	2.1.1d	1c	Ws 120 Splice at FS 1303 Lower Surface	120	1303			Panel Tab	Double Edge Thru, ECP 6512
5	Center Wing	2.1.2	1d	WS 120 Splice at FS 1332 Lower Surface	120	1332			Splice Plate	Double Edge Part Thru
6	Center Wing	2.1.3a	3b	Spanwise Splice at FS 1303 Lower Surface		1303			Panel 4	Single Edge Thru
7	Center Wing	2.1.3b	3b	Spanwise Splice at FS 1303 Lower Surface		1303			Panel 4	Double Edge Thru
8	Center Wing	2.1.4a	6a	Spanwise Splice At BL 101 Lower Surface			101		Panel 1	Single Edge Thru
9	Center Wing	2.1.4b	6a	Spanwise Splice At BL 101 Lower Surface			101		Panel 1	Double Edge Part Thru
10	Center Wing	2.1.5a	4f	Cap-to-Web Splice, Rear Beam at BL 26 Lower Surface			26		Web	
11	Center Wing	2.1.5b	4f	Cap-to-Web Splice, Rear Beam at BL 26 Lower Surface			26		Web	ECP 885-37
12	Center Wing	2.1.5c	4f	Cap-to-Web Splice, Rear Beam at BL 26 Lower Surface			26		Cap	Double Edge Part Thru, Config 1
13	Center Wing	2.1.5d	4f	Cap-to-Web Splice, Rear Beam at BL 26 Lower Surface			26		Cap	Double Edge Part Thru, Config 1, ECP
14	Center Wing	2.1.5e	4f	Cap-to-Web Splice, Rear Beam at BL 26 Lower Surface			26		Cap	Double Edge Part Thru, Config 2
15	Center Wing	2.1.5f	4f	Cap-to-Web Splice, Rear Beam at BL 26 Lower Surface			26		Cap	Double Edge Part Thru, Config 2, ECP
16	Center Wing	2.1.5g	4f	Cap-to-Web Splice, Rear Beam at BL 26 Lower Surface			26		Cap	Double Edge Part Thru, Config 3
17	Center Wing	2.1.5h	4f	Cap-to-Web Splice, Rear Beam at BL 26 Lower Surface			26		Cap	Double Edge Part Thru, Config 3, ECP
18	Inner Wing	2.2.1a	1a	WS 120 Splice at FS 1347 Upper Surface	120	1347			Panel Tab	Single Edge Thru
19	Inner Wing	2.2.1b	1a	WS 120 Splice at FS 1347 Upper Surface	120	1347			Panel Tab	Single Edge Thru, ECP
20	Inner Wing	2.2.2	2a	WS 577 Splice at Front Beam Lower Surface	577				Panel Tab	Double Edge Part Thru
21	Inner Wing	2.2.3	3a	Spanwise Splice at IWBRS 269 Lower Surface at Mid Beam Cap					Panel 4	Double Edge Part Thru
22	Inner Wing	2.2.4a	4a	Cap Tab-Out Front Beam Lower Surface at WS 444	444				Cap	Single Edge Thru
23	Inner Wing	2.2.4b	4a	Cap Tab-Out Front Beam Lower Surface at WS 444	444				Cap	Single Edge Thru, ECP
24	Inner Wing	2.2.5a	4b	Cap Tab-Out Rear Beam Lower Surface at WS 432	432				Cap	Double Edge Thru
25	Inner Wing	2.2.5b	4b	Cap Tab-Out Rear Beam Lower Surface at WS 432	432				Cap	Double Edge Thru, ECP
26	Inner Wing	2.2.6a	4d	Riser-to-Web Splice at WS 327 Lower Surface Mid Beam	327				Cap Riser	Single Edge Thru
27	Inner Wing	2.2.6b	4d	Riser-to-Web Splice at WS 327 Lower Surface Mid Beam	327				Web	Single Edge Thru
28	Inner Wing	2.2.7a	4e	Riser-to-Web Splice at WS 215 Lower Surface Rear Beam	215				Web	Double Edge Thru
29	Inner Wing	2.2.7b	4e	Riser-to-Web Splice at WS 215 Lower Surface Rear Beam	215				Web	Single Edge Thru
30	Inner Wing	2.2.7c	4e	Riser-to-Web Splice at WS 215 Lower Surface Rear Beam	215				Cap Riser	Single Edge Thru
31	Inner Wing	2.2.8a	7a	Riser-to-Web Splice at WS 132 Lower Surface Mid Beam	132				Cap Riser	Single Edge Part Thru
32	Inner Wing	2.2.8b	7a	Riser-to-Web Splice at WS 132 Lower Surface Mid Beam	132				Cap Riser	Single Edge Thru
33	Inner Wing	2.2.8c	7a	Riser-to-Web Splice at WS 132 Lower Surface Mid Beam	132				Cap Riser	Single Edge Thru, ECP
34	Inner Wing	2.2.9a	7b	Riser-to-Web Splice at WS 130 Rear Beam Lower Surface	130				Cap	Double Edge Part Thru
35	Inner Wing	2.2.9b	7b	Riser-to-Web Splice at WS 130 Rear Beam Lower Surface	130				Cap	Single Edge Thru
36	Inner Wing	2.2.9c	7b	Riser-to-Web Splice at WS 130 Rear Beam Lower Surface	130				Cap	Single Edge Thru, ECP
37	Inner Wing	2.2.9d	7b	Riser-to-Web Splice at WS 130 Rear Beam Lower Surface	130				Web	Single Edge Thru, ECP
38	Inner Wing	2.2.10	7c	Riser-to-Web Splice at WS 130 Rear Beam Upper Surface	130				Cap	Single Edge Thru
39	Inner Wing	2.2.11a	5a	Panel Run Out at WS 145 Lower Surface	145				Panel 4	Corner Radius at edge of Panel
40	Inner Wing	2.2.11b	5a	Panel Run Out at WS 145 Lower Surface	145				Panel 4	Corner Radius at edge of Panel, ECP
41	Inner Wing	2.2.11c	5a	Panel Run Out at WS 145 Lower Surface	145				Panel 4	Single Edge Thru at edge of Hole

Table 2.19 (2 pages) C-5A Galaxy, ACCESS Table of DTA Points (Reference [24]).

ID	Airframe Section	Ref. [24] Section #	DTA ID #	Description	WS	FS	BL	WL	Component	Crack Configuration
42	Inner Wing	2.2.11d	5a	Panel Run Out at WS 145 Lower Surface	145				Panel 4	Single Edge Thru at edge of Hole, ECP
43	Inner Wing	2.2.11e	5a	Panel Run Out at WS 145 Lower Surface	145				Mid Beam Cap	Single Edge Thru at edge of Hole
44	Inner Wing	2.2.11f	5a	Panel Run Out at WS 145 Lower Surface	145				Mid Beam Cap	Single Edge Thru at edge of Hole, ECP
45	Inner Wing	2.2.12a	5c	Panel Run Out at WS 450 Lower Surface	450				Panel 3	Corner Radius at edge of Panel
46	Inner Wing	2.2.12b	5c	Panel Run Out at WS 450 Lower Surface	450				Panel 3	Corner Radius at edge of Panel, ECP
47	Inner Wing	2.2.12c	5c	Panel Run Out at WS 450 Lower Surface	450				Panel 3	Single Edge Thru at edge of Hole
48	Inner Wing	2.2.12d	5c	Panel Run Out at WS 450 Lower Surface	450				Panel 3	Single Edge Thru at edge of Hole, ECP
49	Inner Wing	2.2.12e	5c	Panel Run Out at WS 450 Lower Surface	450				Mid Beam Cap	Single Edge Thru at edge of Hole
50	Inner Wing	2.2.12f	5c	Panel Run Out at WS 450 Lower Surface	450				Mid Beam Cap	Single Edge Thru at edge of Hole, ECP
51	Inner Wing	2.2.13a	8a	Pylon Back-up Fitting Inboard Pylon, Inboard Rib					Rib Fitting	Double Edge Part Thru
52	Inner Wing	2.2.13b	8a	Pylon Back-up Fitting Inboard Pylon, Inboard Rib					Rib Fitting	Single Edge Thru
53	Outer wing	2.3.1a	4c	Tab-out at WS 667 Rear Beam Lower Surface	667				Cap	Double Edge Thru
54	Outer wing	2.3.1b	4c	Tab-out at WS 667 Rear Beam Lower Surface	667				Cap	Double Edge Thru, ECP
55	Outer wing	2.3.2a	5b	Panel Run Out At WS 694 Lower Surface	694				Panel 6	Corner Radius at edge of panel
56	Outer wing	2.3.2b	5b	Panel Run Out At WS 694 Lower Surface	694				Panel 6	Single Edge Thru at hole
57	Fuselage	3.1.1	F1	Bulkhead Fitting, Visor Actuator Attach		303	0	325	4F11747 Ftg.	Stress Corrosion, Edge Thru
58	Fuselage	3.1.2	F7	Fuselage Cap Top Upper Sill		370		372	4F11711 Channel	Double Edge Thru
59	Fuselage	3.1.3	F8	Fuselage Cap Top External Skin at Post #2		366		350	4F11206 Skin	Single Edge Thru
60	Fuselage	3.1.4	F5	Upper Lobe Skin, F.S. 1106, Strgr. #96		1106			General Skin	Double Edge Thru
61	Landing Gear	3.1.5a	G1	NLG Outer Cylinder					4G51436	Semi Circular Surface
62	Fuselage	3.2.1	F13	F.S. 1106.383 Frame Cap, Wing Attach	120	1106			4F23016	Single Edge Thru
63	Fuselage	3.2.2	F6	F.S. 1303, W.S. 120, Wing to Frame Attachment Angle	120	1303		314	4F23848	Single Edge Thru
64	Fuselage	3.2.3	F2	F.S. 1383, MLG Frame, Fail-Safe Strap	120	1383		314	4F23014	Double Edge Corner
65	Fuselage	3.3.1	F9	Upper Lobe Skin, F.S. 1563, Strgr. #96		1563			General Skin	Double Edge Thru
66	Fuselage	3.3.2	F14	Upper Lobe Skin, F.S. 1675, Strgr. #96		1675			General Skin	Double Edge Thru
67	Fuselage	3.3.3	F3	Upper Lobe Skin, F.S. 1724, Strgr. #96		1724			General Skin	Double Edge Thru
68	Fuselage, Aft	3.3.4	F10	Upper Lobe Skin, F.S. 1804, Strgr. #96		1804			General Skin	Double Edge Thru
69	Fuselage, Aft	3.3.5	F11	Upper Lobe Skin, F.S. 1984, Strgr. #96		1984			General Skin	Double Edge Thru
70	Fuselage, Aft	3.4.1	F12	F.S. 2538.87 Fin Support Ftg.		2538	0	424.6	4F43250	Stress Corrosion
71	Fuselage, Aft	3.4.2	F4	F.S. 2557 Fin Support Structure		2557		424	4F43315	Double Edge Corner
72	Empennage Tail	3.4.3	T2	Horizontal Stabilizer Internal Fitting For Pitch Trim Actuator			0		4T33063	Single Edge Thru
73	Empennage Tail	3.4.4	T1	Horizontal Stabilizer Upper Surface Box Beam					4T32106	Double Edge Corner
74	Pylon	4.1a	P1	Aft Truss (Outboard Pylon)		344		195	Truss Cap	Single Edge Thru
75	Pylon	4.1b	P1	Aft Truss (Outboard Pylon)		344		195	Truss Cap	Double Edge Thru
76	Pylon	4.2	P2	Aft Lug (Outboard Pylon)		344		195	Lug	Single Edge Part Thru, in outer lug
77	Pylon	4.3	P3	Fwd Lug (Inboard Pylon)					Lug	Single Edge Part Thru in lug

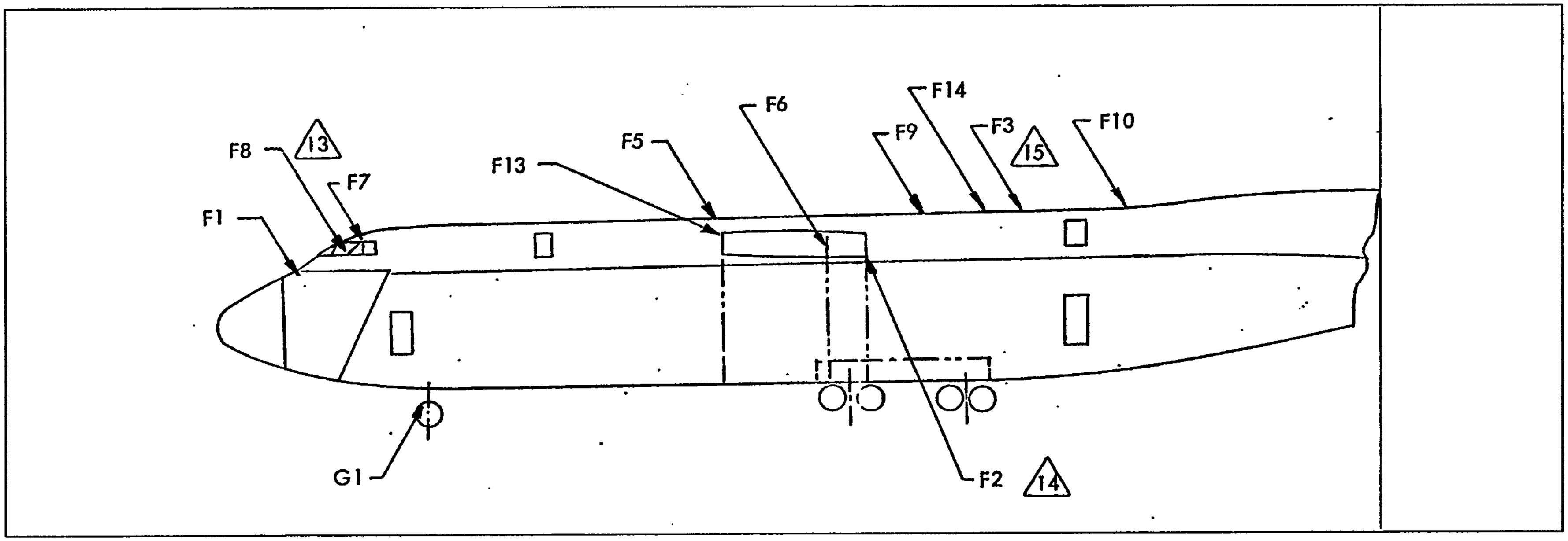


Figure 2.2 C-5A Galaxy Fuselage Analysis Points

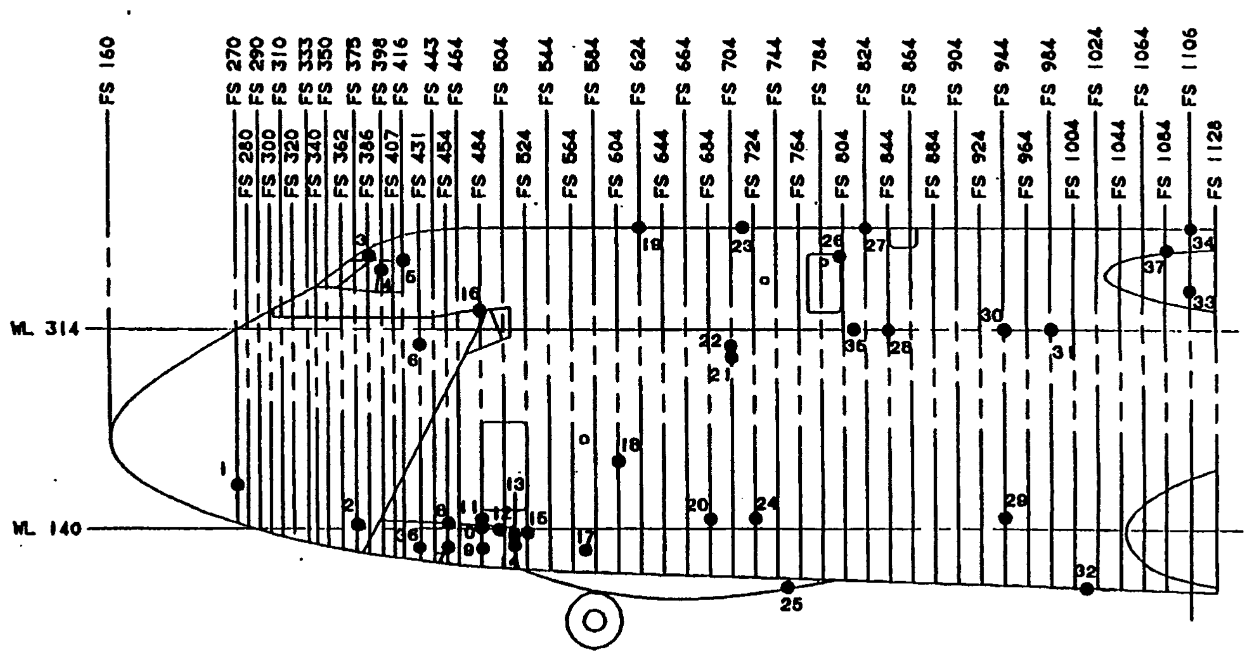


Figure 2.3 C-5B Galaxy Forward Fuselage Analysis Locations

Table 2.20 C-5A/B Galaxy, Content Information for the C5-ALC.mdb Database (SA/ALC Engineering Disposition Records).

C5-ALC.mdb	C5-ALC.mdb	C5-ALC.mdb	C5-ALC.mdb	C5-ALC.mdb	C5-ALC.mdb	C5-ALC.mdb	C5-ALC.mdb	C5-ALC.mdb	C5-ALC.mdb	C5-ALC.mdb	C5-ALC.mdb
ALL88-96	C5A DTA Points	CLOSD88	CLOSD89	CLOSD90	CLOSD91	CLOSD92	CLOSD93	CLOSD94	CLOSD95	CLOSD96	CLOSD97
4302	77	11	425	541	558	373	527	706	642	519	3
124	C-5A	2	17	20	17	21	33	37	39	38	2
Record	ID	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN
IN	Airframe Section	OUT	OUT	OUT	OUT	OUT	OUT	OUT	OUT	OUT	OUT
OUT	DTA Analysis Report Section #	EAR_NO	EAR_NO	EAR_NO	EAR_NO	EAR_NO	EAR_NO	EAR_NO	EAR_NO	EAR_NO	EAR_NO
EAR_NO	DTA ID #	SER_NO	SER_NO	SER_NO	SER_NO	SER_NO	SER_NO	SER_NO	SER_NO	SER_NO	SER_NO
SER_NO	Description	DESCRIPTIO	DESCRIPTIO	DESCRIPTIO	DESCRIPTIO	DESCRIPTIO	DESCRIPTIO	DESCRIPTIO	DESCRIPTIO	DESCRIPTIO	DESCRIPTIO
DESCRIPTIO	WS	STATUS	STATUS	STATUS	STATUS	STATUS	STATUS	STATUS	STATUS	STATUS	STATUS
STATUS	FS	REMARKS	REMARKS	REMARKS	REMARKS	REMARKS	REMARKS	REMARKS	REMARKS	REMARKS	REMARKS
REMARKS	BL	PART_NO	PART_NO	PART_NO	PART_NO	PART_NO	PART_NO	PART_NO	PART_NO	PART_NO	PART_NO
PART_NO	WL	DWG_TO_NO	DWG_TO_NO	DWG_TO_NO	DWG_TO_NO	DWG_TO_NO	DWG_TO_NO	DWG_TO_NO	DWG_TO_NO	DWG_TO_NO	DWG_TO_NO
DWG_TO_NO	Component	WORK_SPEC	WORK_SPEC	WORK_SPEC	WORK_SPEC	WORK_SPEC	WORK_SPEC	WORK_SPEC	WORK_SPEC	WORK_SPEC	WORK_SPEC
WORK_SPEC	Crack Configuration	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
FS	Crack Growth w/ Once Per Lifetime Stress, Flt Hrs	AREA	AREA	AREA	AREA	AREA	AREA	AREA	AREA	AREA	AREA
AREA	Crack Growth w/ Limit Stress, Flt Hrs	REPAIR_INS	REPAIR_INS	REPAIR_INS	REPAIR_INS	REPAIR_INS	REPAIR_INS	REPAIR_INS	REPAIR_INS	REPAIR_INS	REPAIR_INS
REPAIR_INS	Notes	ENGR	ENGR	ENGR	ENGR	ENGR	ENGR	ENGR	ENGR	ENGR	ENGR
ENGR											

SECTION 3

Task 2 - Assess Corrosion/WFD Data and Categorize Effected Components

3.0 Introduction

This section is organized into subsections, one for each selected aircraft. Each subsection discusses the assessment of the damage caused by corrosion and fatigue and then the categorization of the affected parts and locations. The intent of this section is to estimate the extent of corrosion and fatigue damage that exists in the selected USAF aircraft fleets. The extent of damage is illustrated by developing Pareto trends (ranking) grouped by PSE type, location, and damage type/severity.

In general, the method used to identify durability and damage tolerant structural elements for this effort is based on the categorizations and structural element key words documented by the FAA in Section 4.2 of Reference [2] and by Boeing for the 707 in Reference [15]. The FAA identifies structural elements by beginning with four basic definitions listed in Table 3.1 and illustrated in Figure 3.1.

The FAA also categorizes structural element key words for the major airframe sections such as wing, empennage, and fuselage. The list includes commonly recognized airframe structural element terms such as: Angles, Beams, Beam Caps, Bulkheads, Doors, Fittings, Frames, Hinges, Planks, Panels, Plates, Posts, Skins, Spar caps, Spar webs, Spars, Splices, Stringers, and Tracks. This list is useful in querying the database text fields, which describe the damage and the effected component.

Recall that the databases gathered for use under this effort were generally developed for reasons other than tracking damage trends. Therefore, the approach taken here was to first query the databases to identify some relevant details and features of each database. Next, each database was queried to identify specific items such as damage type, part type, and part/damage location. Then, the data trends were cross-referenced (cross-tabbed) to identify significant groupings of data such as DADTA points. Finally, the data trends were reviewed to identify similarities and differences between each of the databases covering a fleet.

Table 3.1 FAA Airframe Structural Element Classifications and Definitions from Reference [2].

Airframe Structural Element Classification	Definition
Principal Structural Element (PSE)	Elements which contribute significantly to carrying flight, ground, and pressurization loads and whose failure could result in catastrophic failure of the airplane.
Critical Structural Element (CSE)	Elements whose failure would result in catastrophic failure of the airplane.
Primary Structure	Structure which carries flight, ground, and pressure loads.
Secondary Structure	Structure which carries only air or inertial loads generated in secondary structure.

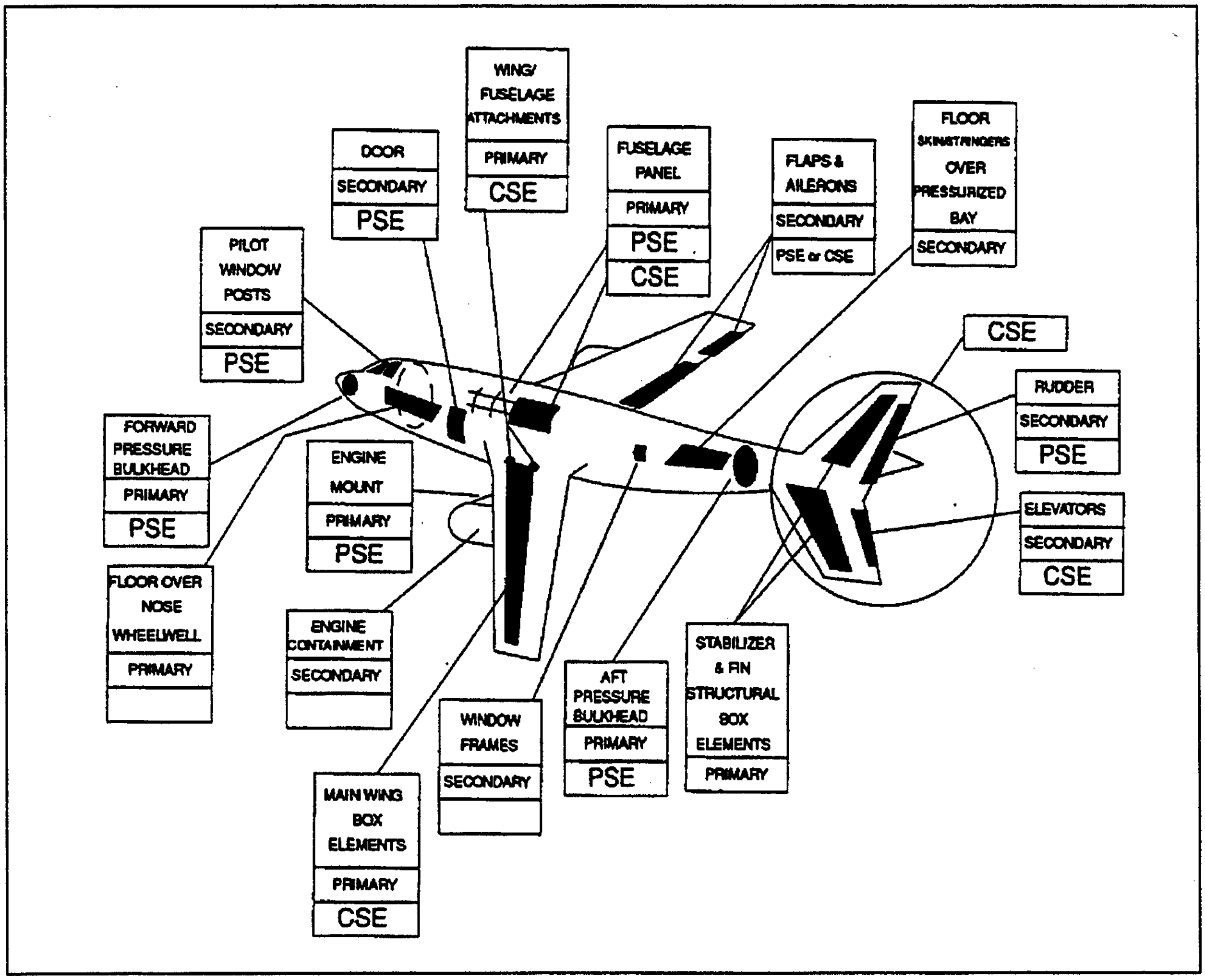


Figure 3.1 FAA Sketch Illustrating Structural Element Types and Names for Transport Aircraft, Reference [2].

3.1 C/KC-135 Stratotanker

Two databases were used to estimate the extent of corrosion and fatigue damage for the C/KC-135 fleet of aircraft. First the OACIS database was queried to generate information covering the entire fleet and then the 291 database was queried in an attempt to develop supporting and more detailed data. The following discusses the database queries and the results they indicate. The results are estimates of which principal structural elements (PSEs) are being found with corrosion and fatigue cracking damage.

3.1.1 C/KC-135 Stratotanker - OACIS

Table 3.2 lists all the queries in the C/KC-135 OACIS database (KC135OACIS.mdb). Note that the query title in the database appears on each figure or table displaying the query results. The first group of OACIS queries is intended to identify general trends in the data concerning corrosion and fatigue cracking. First, the OACIS database was queried to separate the corrosion and cracking damage records from others contained in the database by counting records grouped by the How Malfunction Code (H/M). The results from this query are presented in Table 3.3. Note that of the 5882 total records in the OACIS database, corrosion and cracking account for 4799 records. In OACIS, corrosion is recorded as severe (H/M=667) or mild (H/M=170) while the cracking category (H/M=190) has no associated degree of damage. Of the 4799 records, 78% are attributed to severe corrosion while records attributed to cracking are the smallest group at 6.6%.

Next, three queries were performed which counted records by tail number, work area (W/A), and work unit code (WUC) where, in each case, the How-Malfunction code was limited to severe corrosion, mild corrosion, and cracking (H/M=667, 170, & 190 respectively). The query of records by tail number, presented in sequence indicating production order, is shown in Figure 3.2. This query identifies which aircraft or group of aircraft (by production lot) showed higher occurrences of corrosion and cracking. In this case, the pre 1960 aircraft have about a 15% higher average number of records counted per tail number. This trend is useful to identify unique characteristics of these

aircraft that may drive higher corrosion repair occurrences (i.e. usage, location, materials utilized and cargo type). Note that there are 277 unique tail numbers in the OACIS database with How-Malfunction codes indicating corrosion or cracking damage.

Figures 3.3 and 3.4 show the Pareto trends resulting from queries of OACIS that counted records grouped by W/A and WUC respectively where the H/M code is 667, 170, and 190. The W/A is the location on the airframe where repair actions were performed while the WUC is a specific maintenance action or repair work instruction for specific components and locations. These results identify the work areas where the highest record counts occurred and the work unit codes, which were performed most often. Note that in Figure 3.3 the top three W/A's (12, 16, and 17) each exceed 800 records with the next W/A (19) being below 400 records. The top three work area codes can be identified from Table 2.6 as 12 = Fuselage & A/R Compt (Ext.), 16 = Left wing (ext.), and 17 = Right wing (Ext.). Note that in Figure 3.4 the top two WUC's (11117 and 14ALB) each exceed 300 records with the next WUC (11A20) being below 150 records. The description of the WUC's was not obtained as part of these efforts but could be determined by contacting the C/KC-135 depot at Tinker AFB (OC-ALC). Figure 3.5 presents the Pareto trends from a query that counted records grouped by work zone code where the work area codes were the top three identified above (12, 16, and 17) and the H/M codes were limited to 667, 170, and 190. The work zones (W/Z) are more specific location areas within each W/A. The description of the W/Z's was also not obtained as part of these efforts but could be determined by contacting the C/KC-135 depot at Tinker AFB (OC-ALC). The W/Zs and WUC identified with the highest two or three counts of records could be further investigated under other efforts to identify unique characteristics of these components and locations which may drive the higher than average corrosion occurrences (i.e. material, location, structural assembly type).

The next group of OACIS queries is intended to identify specific PSEs with higher occurrences of corrosion and cracking records. Several queries were performed that counted records grouped by a selected PSE key word where the H/M code is 667, 170, and 190 (corrosion and cracking). Each query counted records where a selected key word occurred in the OACIS text field describing the specific discrepancy. The initial list of PSE key words is identified in Figure 3.1. Several queries and manual reviews of

individual records were performed to select the final list of key words. The Pareto trends, listed in Table 3.4 and shown in Figure 3.6, identify the highest PSE type as "skin" structural elements. The records with a discrepancy text field that identified a "skin" structural element accounts for 33% of the total 8377 records grouped by the 10 PSE key words selected. The majority of the records grouped by "skin" were identified with a How-Malfunction code for severe corrosion (H/M=667).

Note that from the above summary of OACIS records grouped by PSE key words that there is an obvious overlap or double counting of some records between PSE key words. For example, the 1696 records grouped by "skin & mag" (magnesium) were also counted under the "skin" group. A detailed review of individual records for each query indicated that "magnesium skins" account for a large percentage of overlap. Thus the count of records for the "skin & mag" query should be more accurate.

The work area (location) of the damaged (corroded or cracked) PSE's identified in Table 3.4 can also be determined by a cross-tab query on work area code. That is, count records grouped by work area code (W/A) where the PSE key word in the discrepancy text field is (for example) "skin" and the How-Malfunction codes is 667, 170, and 190. The results from this query are listed in Table 3.5. The results from a query counting records by work areas where the PSE key word is "mag" (magnesium) are shown in Figure 3.7. The same W/As identified above with high record counts in the more general queries are also identified here with the "mag" and "skin" groups. Queries to count records by work area for the other PSE key words were also performed. These results are not shown here but are included in the list of queries in the database.

In order to identify problems relevant (timely) to the PDM facility, a query for the occurrence of "mag" was performed grouping record counts by year. These results are shown in Figure 3.8. The listing of record counts by year with the occurrence of "mag" clearly show that the highest count occurred in 1993 and has been declining since. Thus, magnesium components (mostly skins and webs) are clearly no longer a major concern for the PDM depot. This query does however, demonstrate the capability of the database to identify emerging problems.

Clearly cracking is not a high driver of repairs for the C/KC-135 fleet while severe corrosion of PSE's accounts for the large majority of the repairs listed in this OACIS

database. The top three work areas (12 = Fuselage & A/R Compt (Ext.), 16 = Left wing (ext.), and 17 = Right wing (Ext.)) account for over half of the total damage found. The "skin" structural element account for over half of the records counted by a PSE key word search. To better identify the ranking of PSEs with corrosion, a series of queries could be performed searching for records without the occurrence of "mag" to identify the correct count of corrosion records for each PSE group.

Table 3.2 List of Queries in the KC-135 OACIS Access Database (KC135OACIS.mdb).

Names of Queries in KC135OACIS.mdb
KC135 OACIS, H/M, count records
KC135 OACIS, Tail # *291*, 667 170 190, count records
KC135 OACIS, Tail # ?, Date, WUC, W/A, Z, 667&170&190, Ct Rec.
KC135 OACIS, Tail #, 667 170 190, count records
KC135 OACIS, Tail #, 667&170&190, Descrep w/ *beam
KC135 OACIS, Tail #, 667&170&190, Descrep w/ *bulk*
KC135 OACIS, Tail #, 667&170&190, Descrep w/ *keel beam*
KC135 OACIS, Tail #, 667&170&190, Descrep w/ *skin*
KC135 OACIS, Tail #, 667&170&190, Descrep w/ *skin* & *mag*
KC135 OACIS, Tail #, 667&170&190, Descrep w/ *skin* & *wing*
KC135 OACIS, Tail #, Year, 667&170&190, Count Records
KC135 OACIS, W/A 12&16&17, Tail #, 667 170 190, count records
KC135 OACIS, W/A 12&16&17, Z, 667 170 190, CT Rec. w/ Disp *skin*
KC135 OACIS, W/A 12&16&17, Zone, 667 170 190, count records
KC135 OACIS, W/A, 667 170 190, count records
KC135 OACIS, W/A, 667 170 190, Ct Rec. w/ Descrep *beam
KC135 OACIS, W/A, 667 170 190, Ct Rec. w/ Descrep *bulk*
KC135 OACIS, W/A, 667 170 190, Ct Rec. w/ Descrep *keel beam*
KC135 OACIS, W/A, 667 170 190, Ct Rec. w/ Descrep *mag*
KC135 OACIS, W/A, 667 170 190, Ct Rec. w/ Descrep *skin* & *mag*
KC135 OACIS, W/A, 667 170 190, Ct Rec. w/ Descrep *skin* & *wing*
KC135 OACIS, W/A, 667 170 190, Ct Rec. w/ Descrep *spar
KC135 OACIS, W/A, 667 170 190, Ct Rec. w/ Descrep *stringer*
KC135 OACIS, W/A, 667 179 190, Ct Rec. w/ Descrep *frame*
KC135 OACIS, W/A, 667 179 190, Ct Rec. w/ Descrep *skin*
KC135 OACIS, W/A, Year, 667&170&190, Ct Rec. w/ Descrep *mag*
KC135 OACIS, WUC 11117&14ALB, W/A, Z, 667 170 190, Disc w/ *mag*
KC135 OACIS, WUC 11117&14ALB, W/A, Z, 667 170 190, Discrep
KC135 OACIS, WUC, 667 170 190, count records

Table 3.3 KC-135 OACIS, Count Records by How Malfunction Code (H/M).

KC135 OACIS, H/M, count records

Sum	All	5882
Sum	Corrosion & Crack	4799

How Mal	Description	CountOfRecord
667	Corroded Severe	3757
170	Corroded Mild/Moderate	722
190	Cracked	320
553	Does not meet specifications	234
806		200
0		128
799		123
20	Worn, Chaffed, frayed, or torn	51
242		40
917		37
804		35
800		35
105	Loose, damaged, or missing hardware	29
780		21
932		14
846	Delaminated	10
70	Broken	10
865	Deteriorated	7
127		7
607		6
86		5
585	Sheared	4
425		4
750		4
801		4
66		3
911		3
677		3
67		3
730		3
663		3
47 other codes each with counts < 3		57

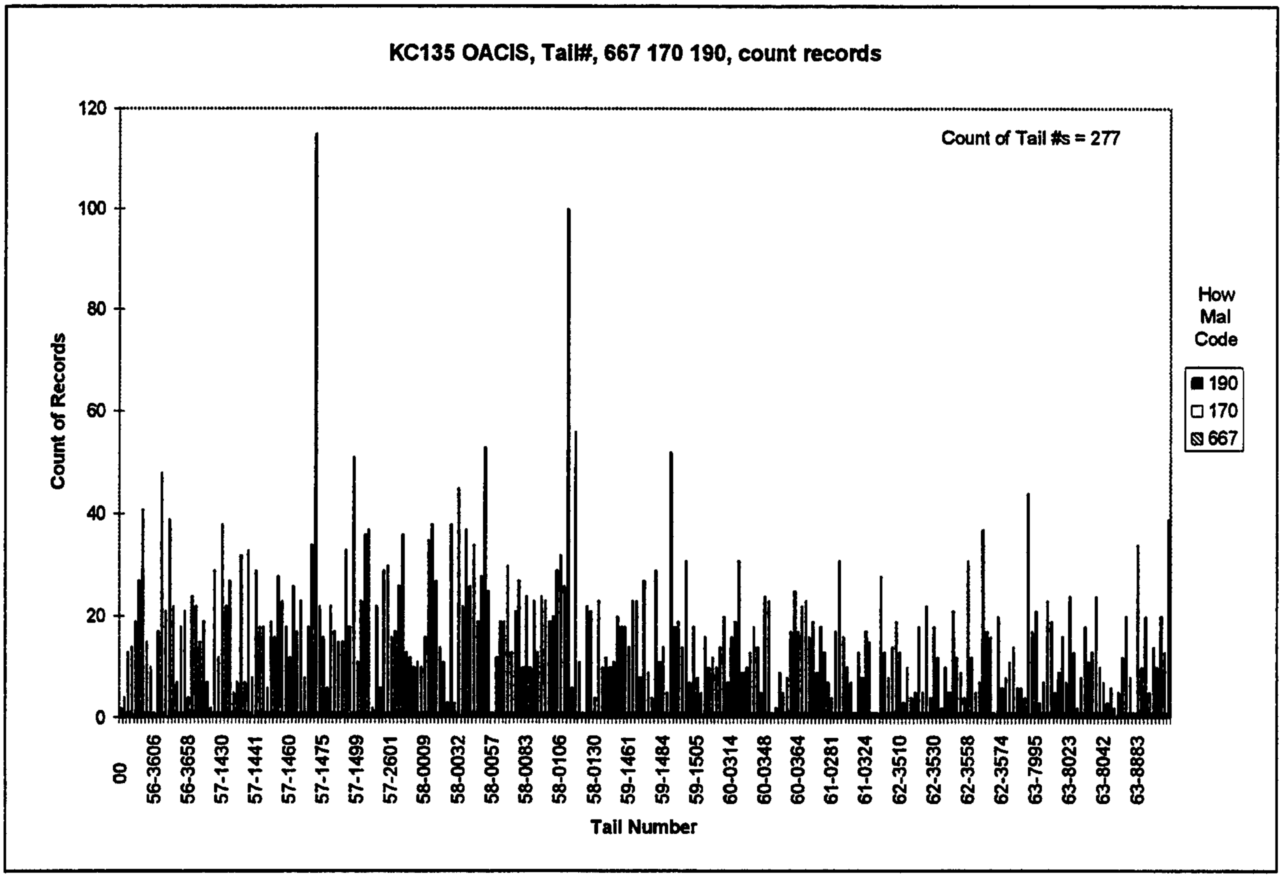


Figure 3.2 KC-135 OACIS, Count Records by Aircraft Tail Number where the How Malfunction (How Mal) Code is 667 (Severe Corrosion), 170 (Mild Corrosion), and 190 (Cracked).

Note that the intent of this figure is to see the trends as a function of the year the airframe was manufactured.

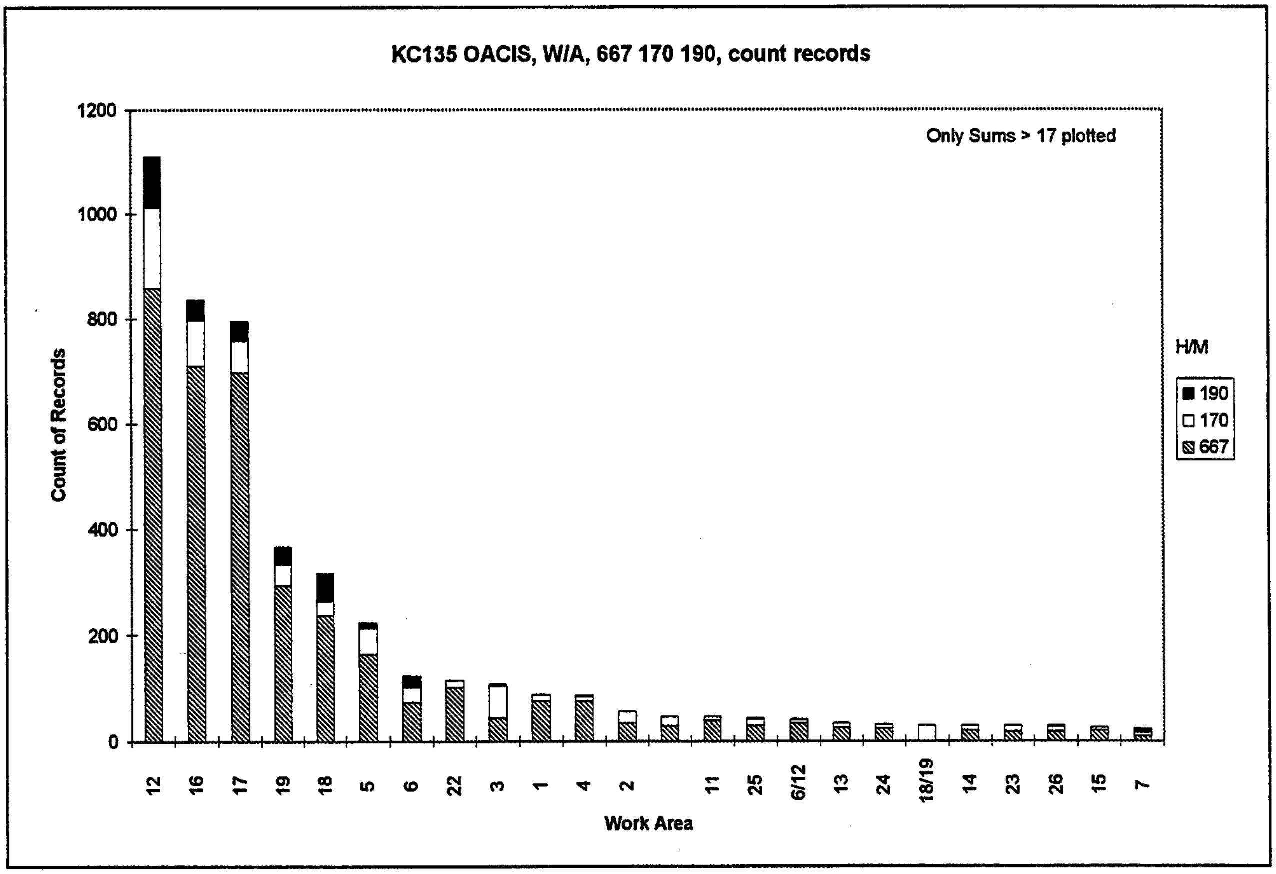


Figure 3.3 KC-135 OACIS, Count Records by Work Area Location Code where the How Malfunction (How Mal) Code is 667 (Severe Corrosion), 170 (Mild Corrosion), and 190 (Cracked).

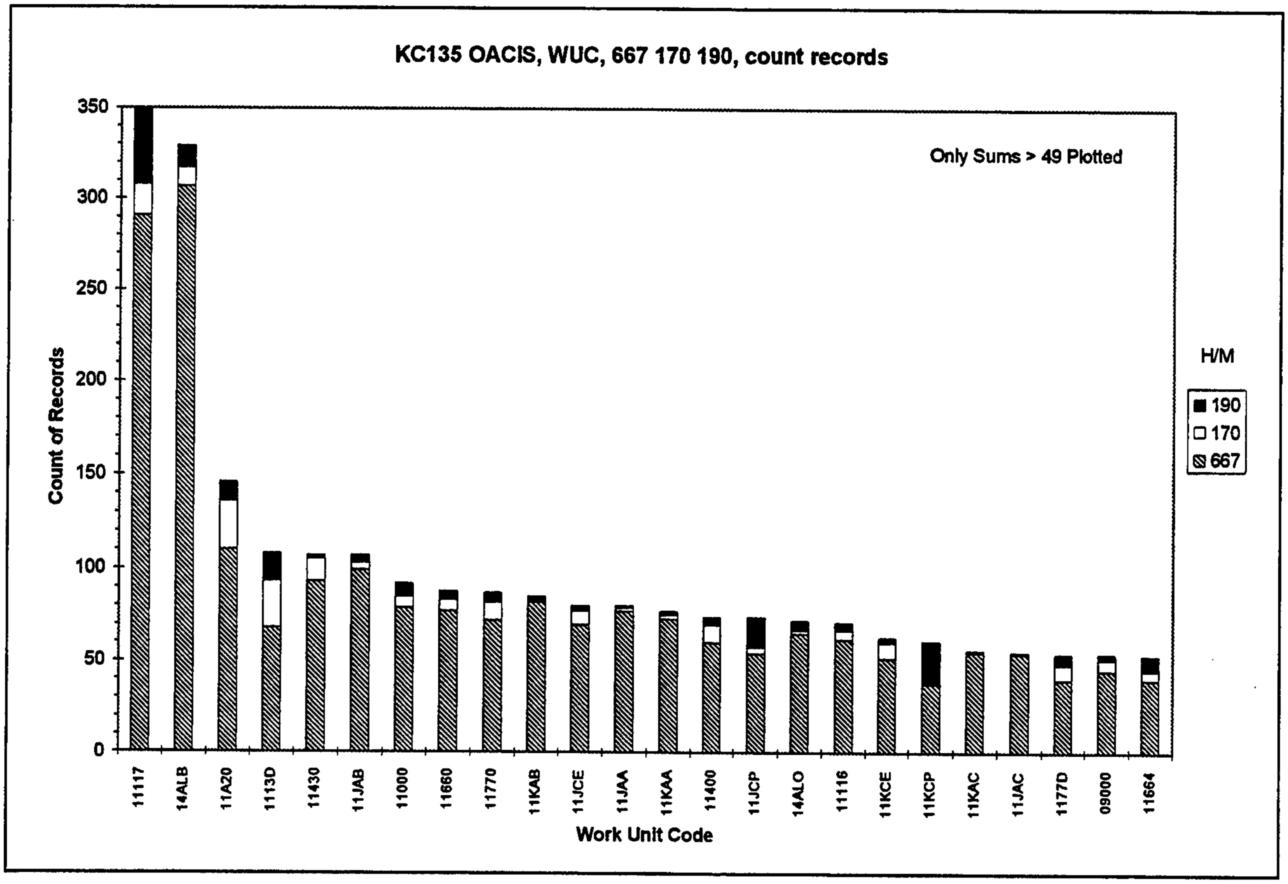


Figure 3.4 KC-135 OACIS, Count Records by Work Unit Code (WUC) where the How Malfunction (How Mal) Code is 667 (Severe Corrosion), 170 (Mild Corrosion), and 190 (Cracked).

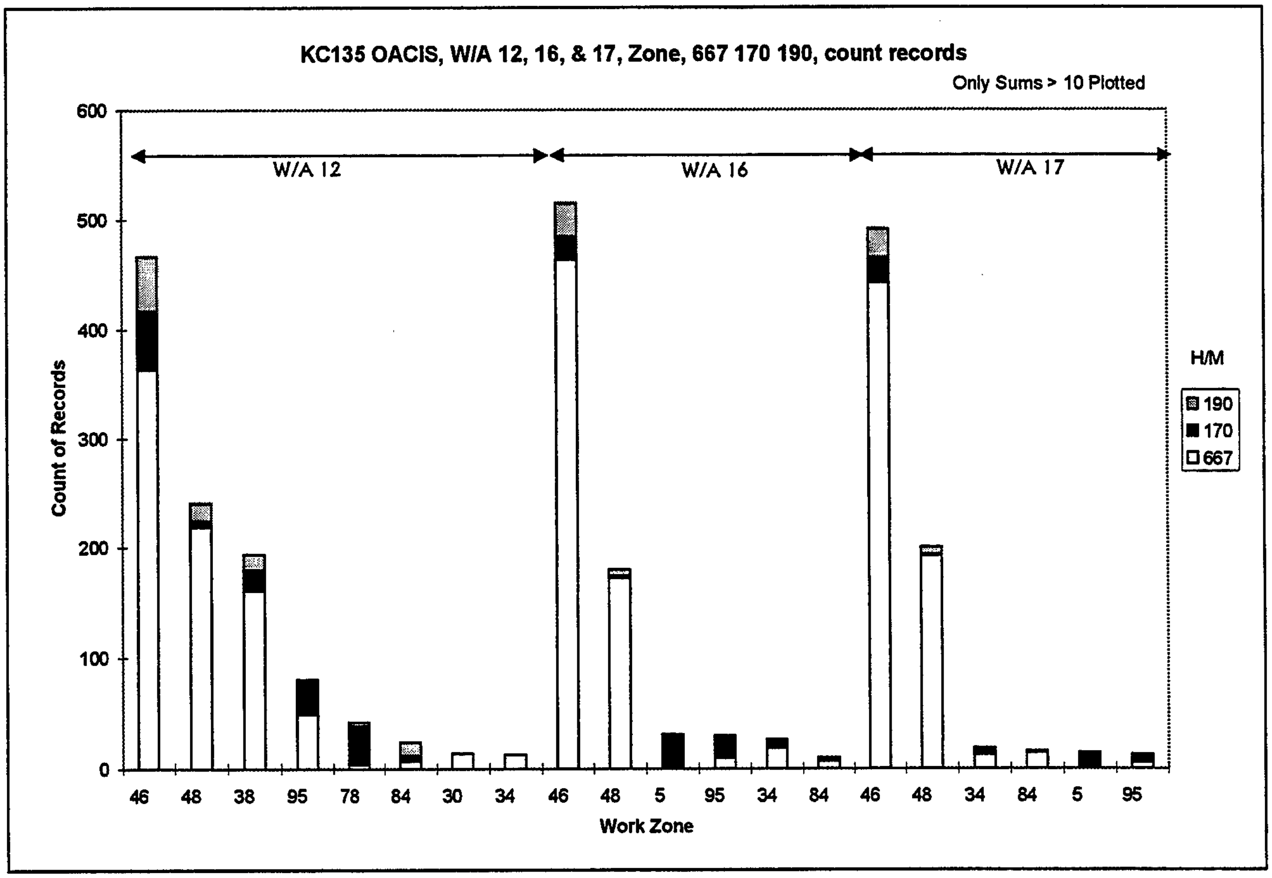


Figure 3.5 KC-135 OACIS, Count Records by Work Zone Location Code where the Work Area Location Code is 12, 16, & 17 and the How Malfunction (How Mal) Code is 667 (Severe Corrosion), 170 (Mild Corrosion), and 190 (Cracked).

Table 3.4 KC-135 OACIS, Count Records by Structural Element Key Word in the Discrepancy Description where the How Malfunction (How Mal) Code is 667 (Severe Corrosion), 170 (Mild Corrosion), and 190 (Cracked).

KC135 OACIS, W/A, 667 170 190, Ct Rec w/ Descrep *?*

Sum = 8377

H/M

Count of Records

Descrepency w/	667	170	190	Sum
skin	2371	192	186	2749
mag	1954	141	203	2298
skin & mag	1460	98	138	1696
skin & wing	654	36	80	770
beam	189	45	23	257
keel beam	170	40	20	230
stringer	146	8	1	155
Spar	79	7	1	87
frame	60	18	7	85
bulk	40	6	4	50

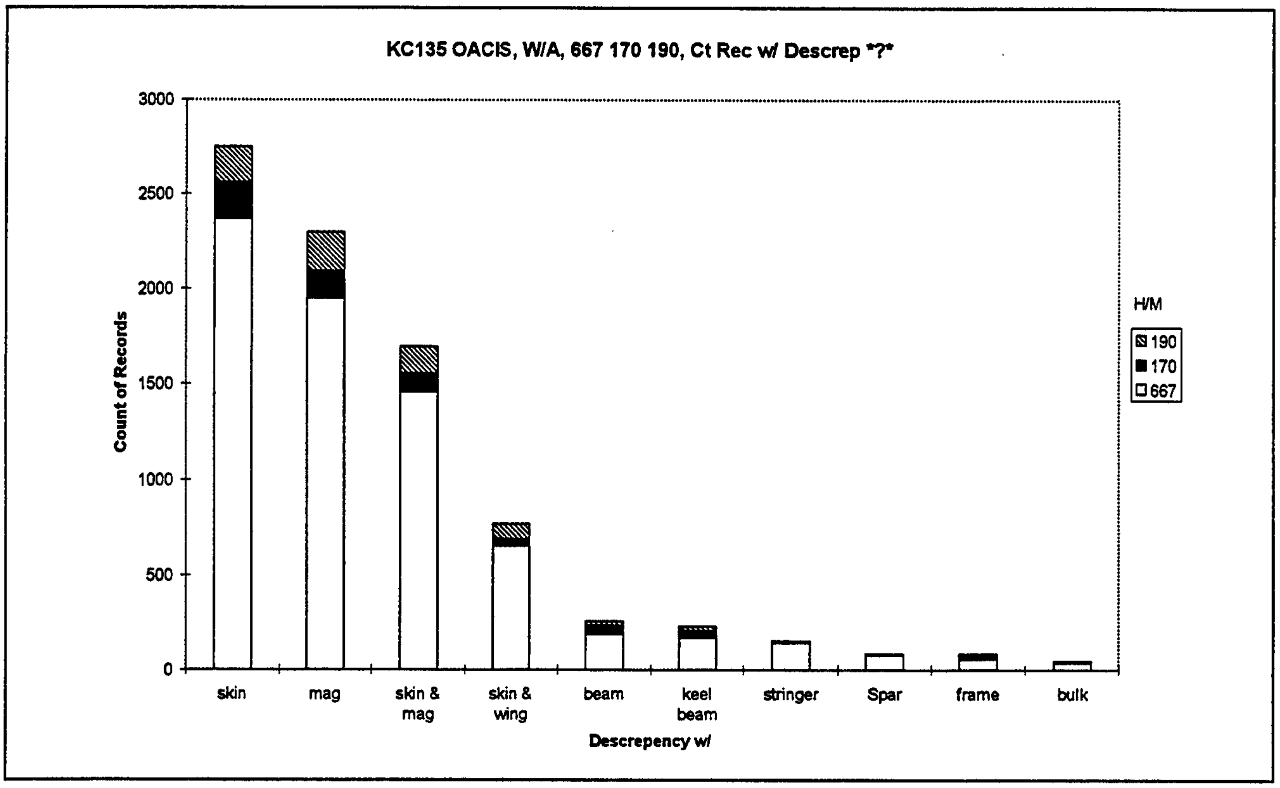


Figure 3.6 KC-135 OACIS, Count Records by Structural Element Key Word in the Discrepancy Description where the How Malfunction (How Mal) Code is 667 (Severe Corrosion), 170 (Mild Corrosion), and 190 (Cracked)

Table 3.5 KC-135 OACIS, Count Records by Work Area Where the Structural Element Key Word = "skin" in the Discrepancy Description and the How Malfunction (How Mal) Code is 667 (Severe Corrosion), 170 (Mild Corrosion), and 190 (Cracked)

KC135 OACIS, W/A, 667 170 190, Ct Rec w/ Descrep *?*

H/M

Count of Records

Descrepency w/	Work Area	667	170	190	sum	SUM
skin	12	584	76	51	711	2749
	16	512	23	26	561	
	17	482	7	19	508	
	19	236	18	22	276	
	18	188	17	44	249	
	22	84	8		92	
	6	56	14	11	81	
	6/12	31	7	1	39	
	5	22	2	2	26	
		13	11	1	25	
	13	17	2		19	
	11	15			15	
	14	12	3		15	
	25	15			15	
	7	8		6	14	
	24	12			12	
	4	12			12	
	23	10			10	
	26	10			10	
	05	8			8	
	1	5	1	1	7	
	17,19	5		1	6	
	16,18	3			3	
	2	1	2		3	
	20	3			3	
	8	3			3	
	04	2			2	
	10	2			2	
	16/17	2			2	
	08	1			1	
	1/4	1			1	
	12/2	1			1	
	12/20	1			1	
	12/22	1			1	
	12/6	1			1	
	15	1			1	
	15/12	1			1	
	16/12	1			1	
	17&19	1			1	
	17/19	1			1	
	20/21	1			1	
	21		1		1	
	21/12			1	1	
	3	1			1	
	3/4	1			1	
	48	1			1	
	6,12	1			1	
	667	1			1	
	7/12	1			1	

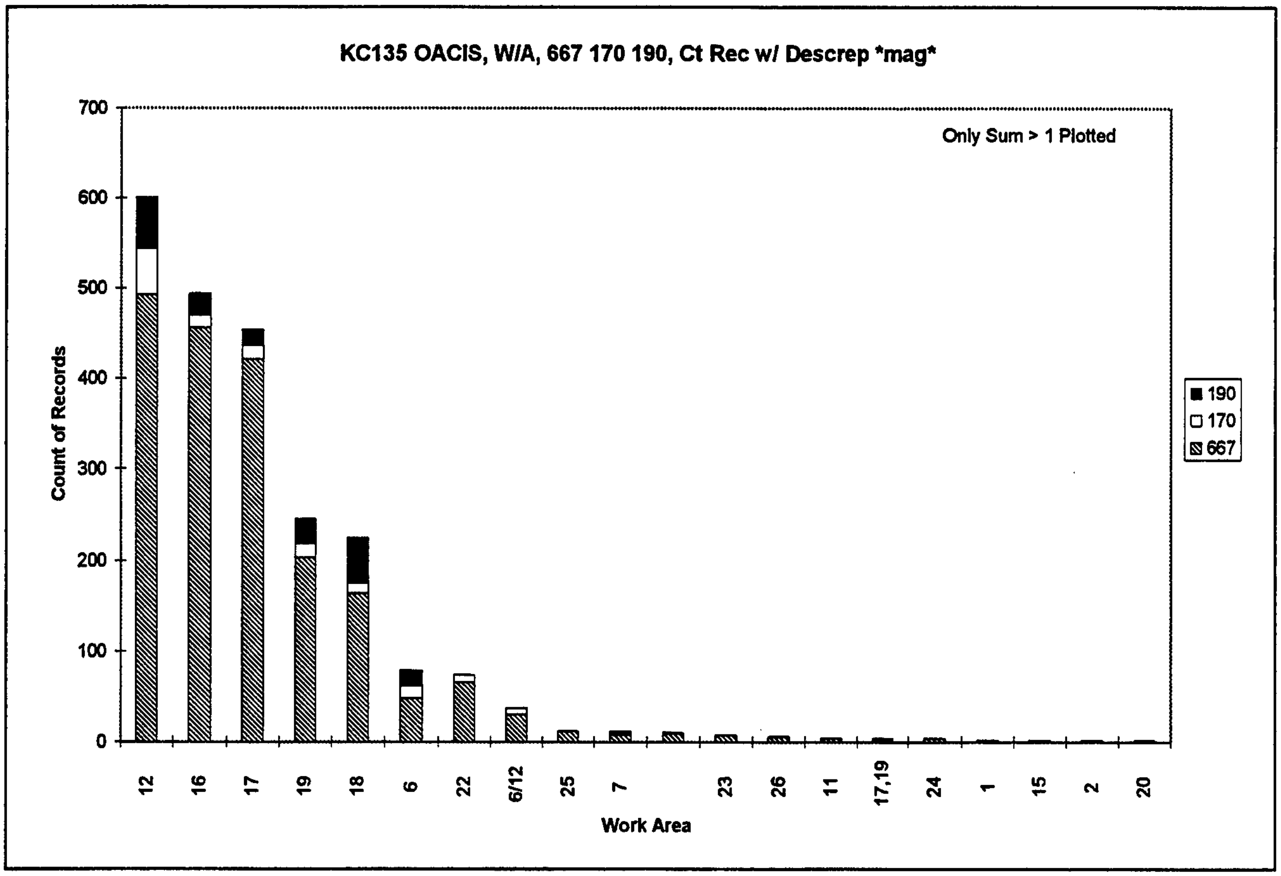


Figure 3.7 KC-135 OACIS, Count Records by Work Area Location Code where the Structural Element Key Word in the Discrepancy Description is "mag" (magnesium) and the How Malfunction (How Mal) Code is 667 (Severe Corrosion), 170 (Mild Corrosion), and 190 (Cracked)

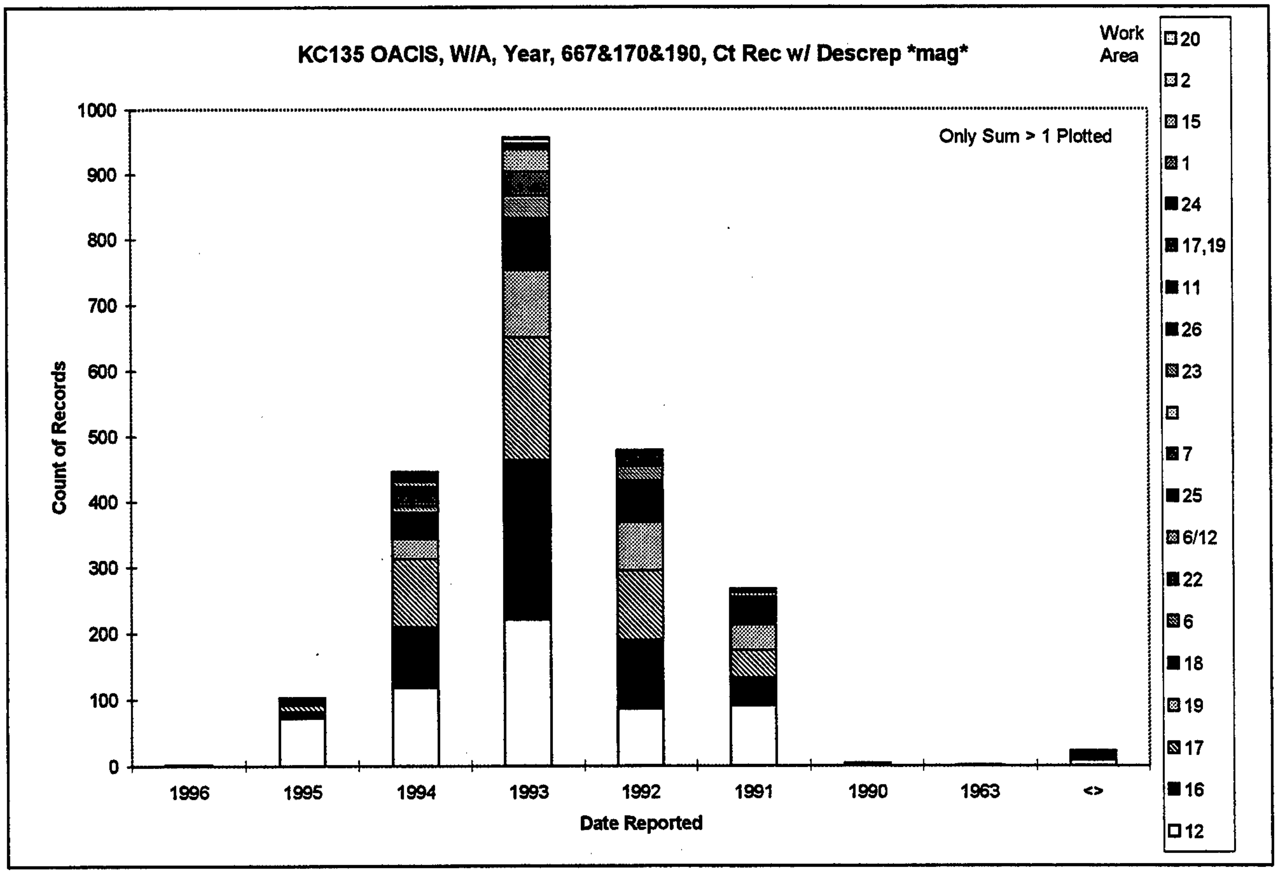


Figure 3.8 KC-135 OACIS, Count Records by Year Cross Tabbed with the Work Area Location Code where the Structural Element Key Word in the Discrepancy Description is "mag" (magnesium) and the How Malfunction (H/M) Code is 667 (Severe Corrosion), 170 (Mild Corrosion), and 190 (Cracked)

3.1.2 C/KC-135 Stratotanker, EC-135H 61-0291

Table 3.6 lists all the query names in the EC-135H-291 Access database (EC135H-291.mdb). Note that the query title in the database appears on each figure or table displaying the query results. Recall that the 291 data is a detailed listing of the corrosion that was found on one aircraft (tail number 61-0291) specifically selected and disassembled to find hidden corrosion. The 61-0291 airframe is reported in Reference [7] to have been through 3 PDM level airframe refurbishment's specifically for corrosion within a 5-year period prior to the disassembly. The results of the 291 disassembly and inspection for corrosion will therefore only indicate the level of corrosion left behind after depot level repairs. Each volume in References [3 – 6] documents the corrosion findings by section number for the many sections cut out from the airframe and then disassembled. Each section in the reports contains two forms of data records, Tabular Data and Corrosion Damage Report text records. The Tabular Data quantifies the corrosion depths found on each piece and the Corrosion Damage Reports describe the structural elements of the section and the damage found on each piece. This includes component description text, damage description text, and a list of damage types with the occurrence indicated by an "x" as a yes/no mark. The Corrosion Damage Reports are also referred to as Part & Corrosion Descriptions.

The first group of 291 database queries was intended to find a common ground or trend with the OACIS database. First, a query of the Tabular Data modified from that reported in References [3 – 6] was performed counting records by Part ID. The Pareto trend appears in Figure 3.9 and indicate the vast range of Part ID descriptions (note that not all Part ID terms are shown). This broad range of part identification terms (including misspelled words) causes inaccurate counts of records for each part grouping. For example "doubler" and "stiffener" (and "stiffener") are often interchangeable terms. Still, the Part ID group "Skin" has the highest record count by more then a factor of 2. This supports the trends developed with OACIS.

Next a query of the Part & Corrosion Descriptions data was performed that counts records grouped by corrosion severity classification (light, moderate, and severe). The results are displayed in Figure 3.10 and indicate that records attributed to

light corrosion outnumber records with moderate and severe corrosion. This result may seem at first to conflict with the trend shown by OACIS as severe corrosion. However, the high count of light corrosion is understandable considering the recent repairs to the 61-0291 airframe for corrosion just prior to the disassembly.

The next series of 291 database queries were intended to supply further detail of the corrosion found on the 61-0291 airframe. The available details identified are corrosion depth and corrosion type. A query of the Part & Corrosion Description records counted records grouped by corrosion type. The Pareto trend from this query is shown in Figure 3.11 and identifies the top three types of corrosion as surface, pitting, and exfoliation with about 1000, 275, and 150 records counted respectively. Three queries were then performed on the Tabular Data counting records grouped by the maximum corrosion depth measured where the corrosion type is surface, pitting and exfoliation. These three Pareto trends are shown in Figures 3.12, 3.13, and 3.14 respectively. In all cases, the large majority of corrosion depths measured are in the range of 0.001 to 0.002 inches deep (light corrosion).

Finally, some information can be discerned about the location of the corrosion damage on the 291 airframe. A query was performed to count records in the Part & Corrosion Description table grouped by section number where surface corrosion is indicated. In addition, a link was used between the Part & Corrosion Description table and the Section Description table, which describes the locations (providing station numbers) of all sections cutout of the 291 airframe. The results from this query are listed in Table 3.7 and indicate that the forward cargo doorsill is identified in 3 of the top 4 sections.

Table 3.6 List of Queries in the EC-135H-291 Access Database (EC-135H-291.mdb).

Name of Queries in EC135H-291.mdb
EC135H-291, P&CD, Corr Severity (L/M/S w/ x), Count Records
EC135H-291, P&CD, Corr types, Count Records
EC135H-291, Vol, Exfoil, Max Depth, Section, Count Records
EC135H-291, Vol, Part ID, Count Records
EC135H-291, Vol, Pitting, Max Depth, Section, Count Records
EC135H-291, Vol, Surface, Max Depth, Section, Count Records
q1 EC135H-291, Vol, Max Depth, Count Records
q2 EC135H-291, P&CD, Section, Surface w/ x, Count Records
q3 EC135H-291, Vol-P&CD, Max Depth, Surface w/ x, Count Records

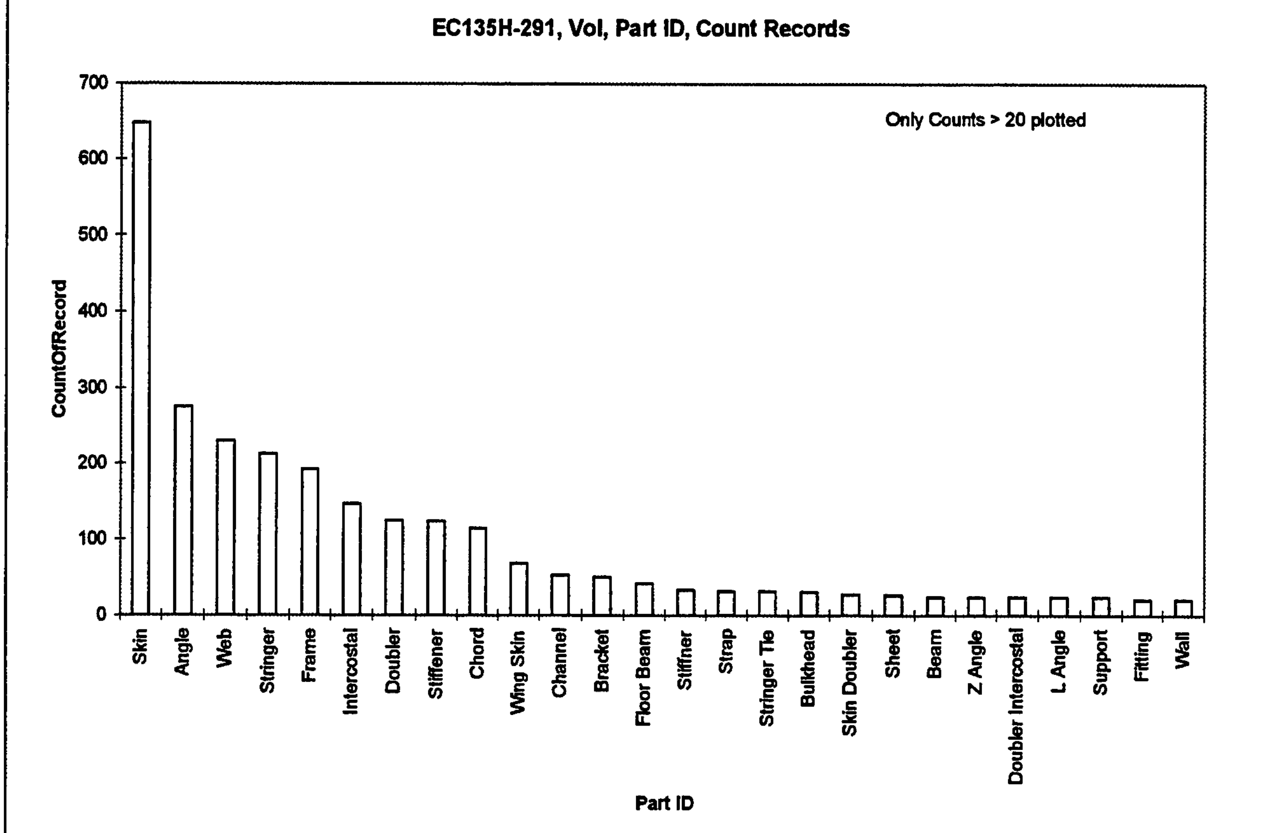


Figure 3.9 EC-135H-291 Tabulated Records Reported in Multiple Volumes, Count Records by Part ID Text.

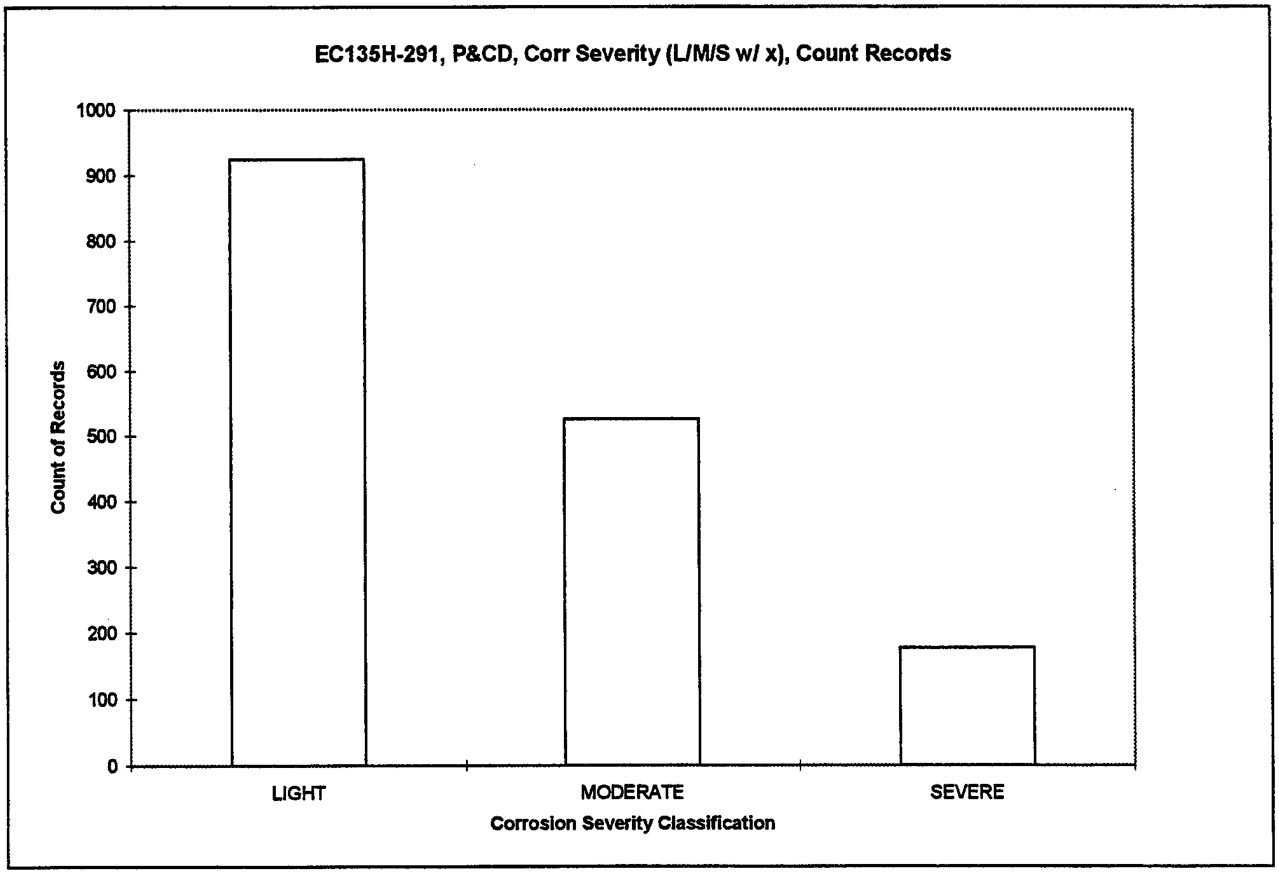


Figure 3.10 EC-135H-291 Part & Corrosion Description Records, Count Records by Corrosion Severity Classification.

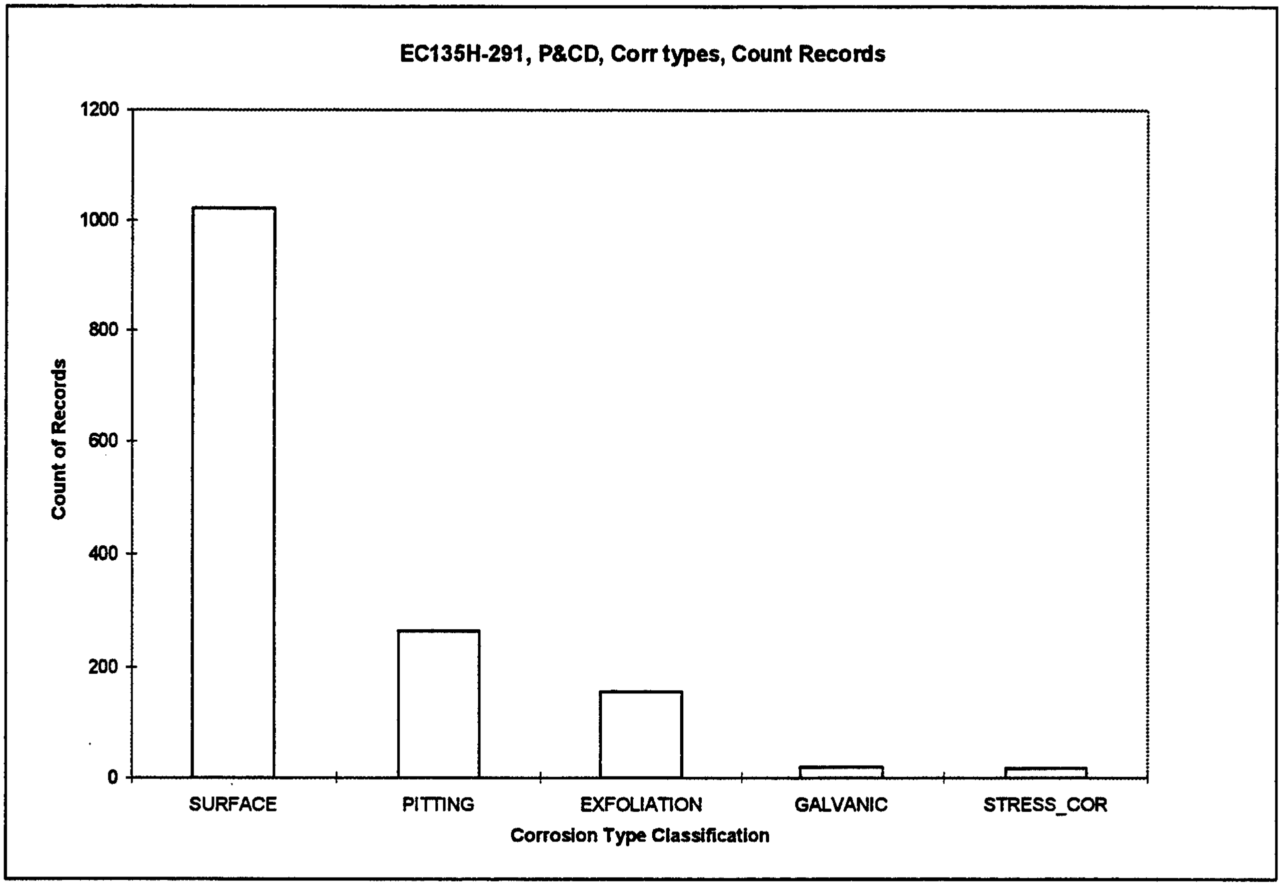


Figure 3.11 EC-135H-291 Part & Corrosion Description Records, Count Records by Corrosion Type Classification.

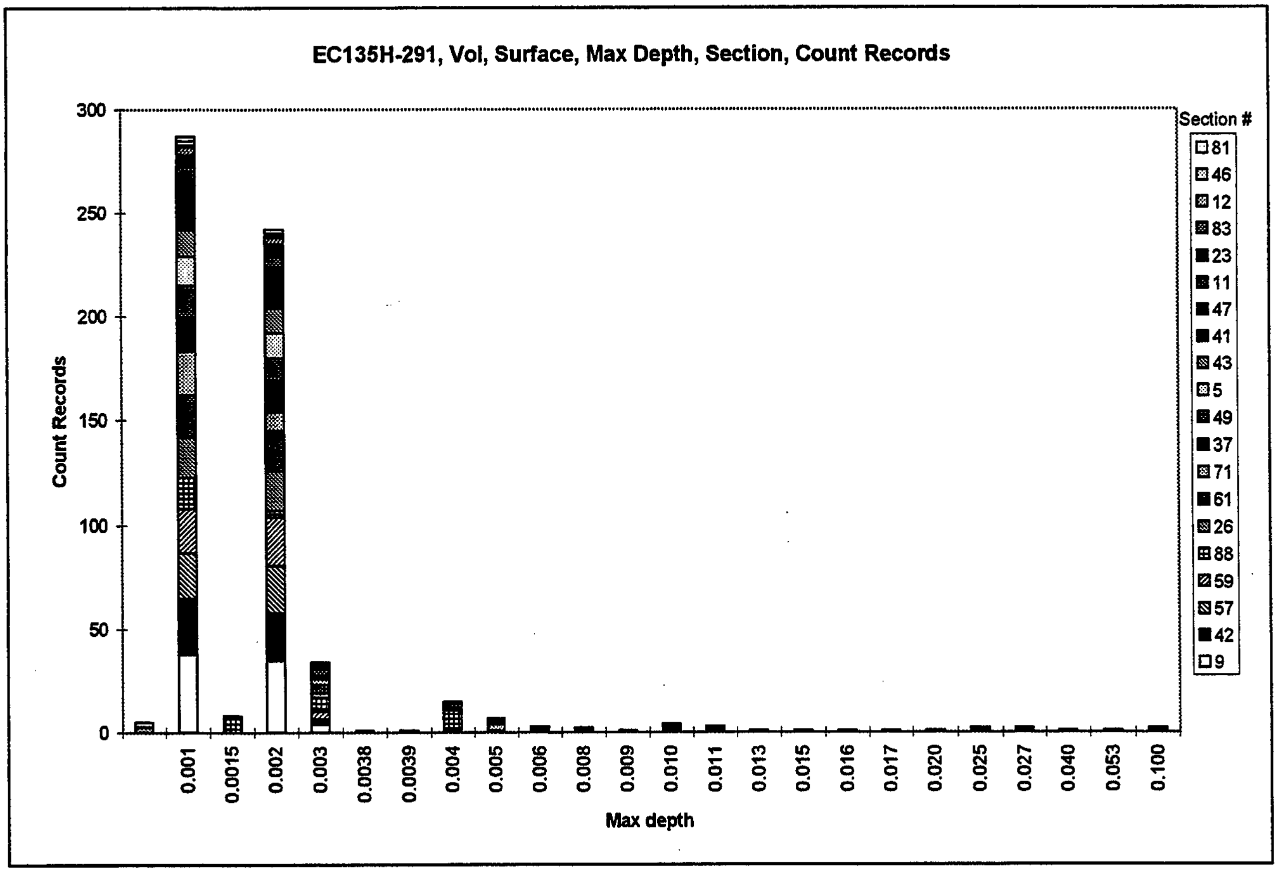


Figure 3.12 EC-135H-291 Tabulated Records Reported in Multiple Volumes, Count Records by Maximum Measured Corrosion Depth for Surface Corrosion Only and Crossed Tabbed by Report Section Number (indicating location).

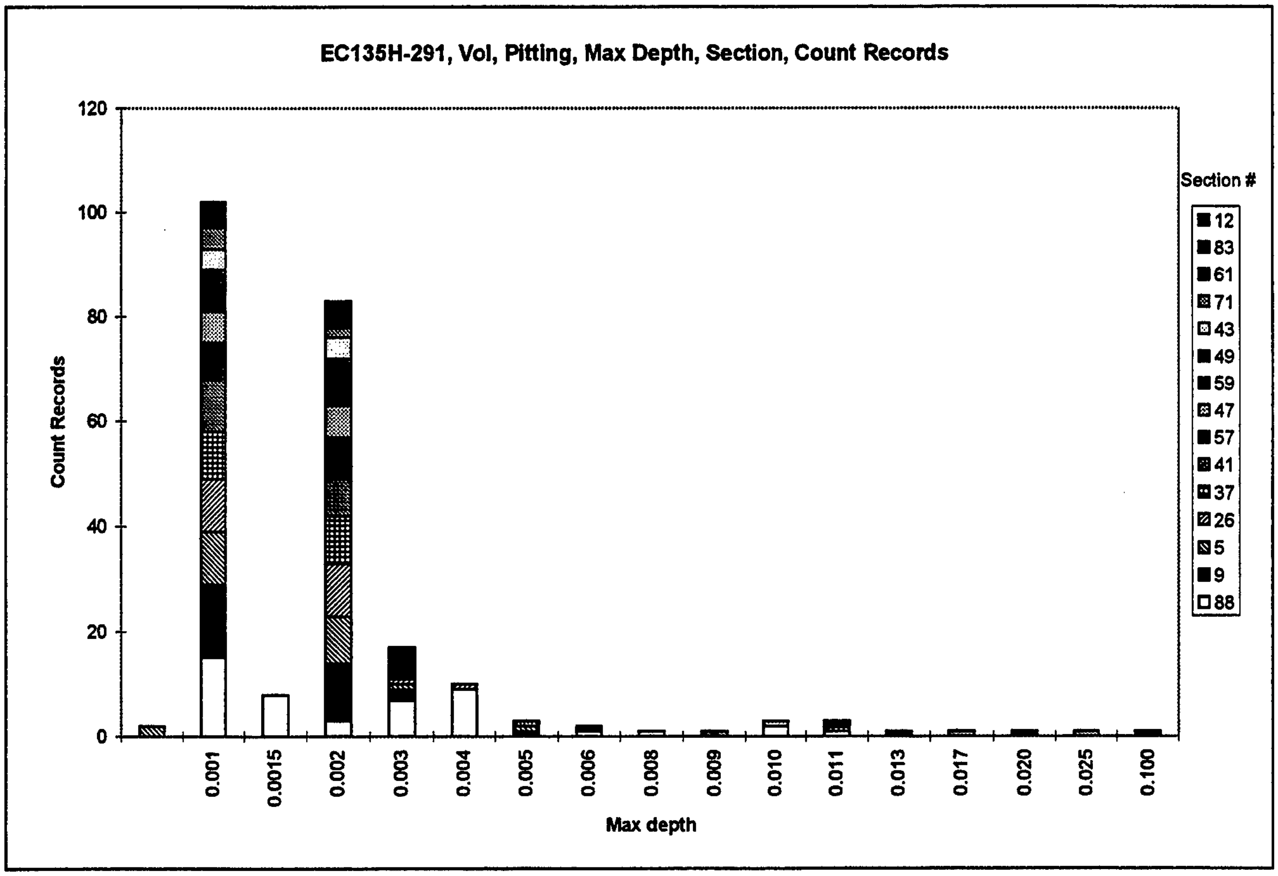


Figure 3.13 EC-135H-291 Tabulated Records Reported in Multiple Volumes, Count Records by Maximum Measured Corrosion Depth for Pitting Corrosion Only and Crossed Tabbed by Report Section Number (indicating location).

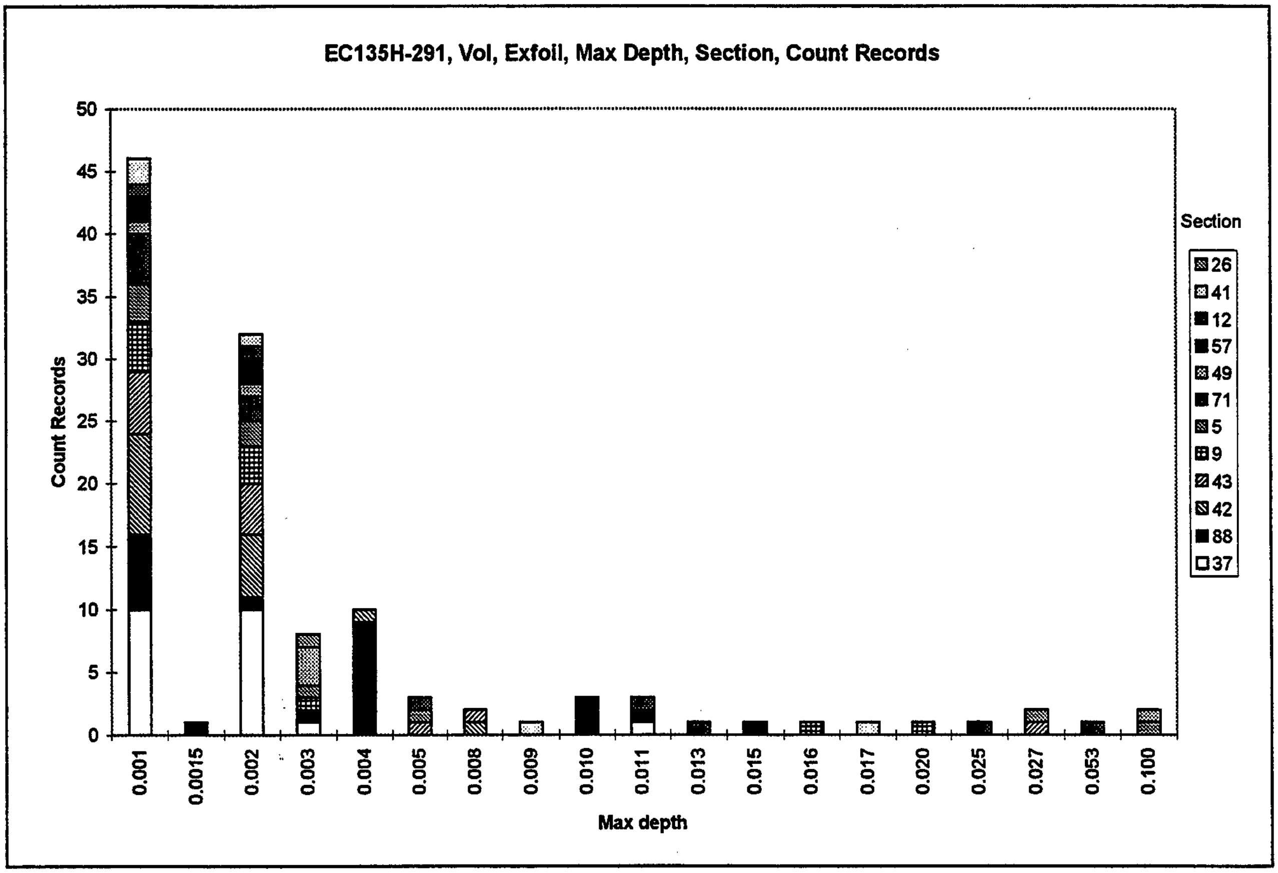


Figure 3.14 EC-135H-291 Tabulated Records Reported in Multiple Volumes, Count Records by Maximum Measured Corrosion Depth for Exfoliation Corrosion Only and Crossed Tabbed by Report Section Number (indicating location).

Table 3.7 EC-135H-291 Part & Corrosion Description Records, Count Number of Records for Surface Corrosion Only Grouped by Report Section Number Linked to Section Description Table (indicating location).

q2 EC135H-291, P&CD, Section, Surface w/ x, Count Records

1022

SECTION	Section Description	Count Of SURFACE
42	LOWER CARGO DOOR SILL, BS 410 TO BS 445	15
49	LOWER CARGO DOOR SILL, BS 480 TO BS 515	15
12	FORWARD UPPER CORNER OF CREW ENTRY CUTOUT	14
46	LOWER CARGO DOOR SILL, BS 445 TO BS 480	12
705		12
29	STA 360 SKIN PANEL AT S-25	11
130	BS 1335 BOOMER'S POD	11
9	BS 259.5 LAP/BUTT SPLICE SKIN SEGMENT AT S-14L	10
59	AFT FUSELAGE SKIN BELOW FORWARD BODY TANK #3	10
125	LOWER FORWARD BILGE AREA OF BOOMER'S POD	10
128	BS 1335 BOOMER'S POD (INCLUDES SECTION 127)	10
61	FUSELAGE SKIN/FLOOR BEHIND AIR DISTRIBUTION DUCTS	9
92	LEFT HAND AFT MAIN LANDING GEAR WHEEL WELL BULKHEAD, BS 960	9
94	LEFT HAND AFT MAIN LANDING GEAR WHEEL WELL BULKHEAD, BS 960 (INCLUDE	9
141	FORWARD FIN FITTINGS AND SEGMENT OF UPPER BS 1440 BULKHEAD	9
144	LOWER RIGHT HAND BS 1440 PRESSURE BULKHEAD	9
280	RIGHT HAND WING REAR SPAR TERMINAL FITTING	9
3	FLOOR UNDER PILOT	8
28	BS 360 SKIN PANEL AT S-19 (INCLUDES PART OF SECTION 18)	8
41	SKIN PANEL FORWARD UPPER CARGO DOOR CUTOUT CORNER	8
57	FORWARD FUSELAGE SKIN BELOW FORWARD BODY TANK #3	8
80	KEEL BEAM, BS 810	8
84	BS 820 BULKHEAD FORGING ABOVE FLOOR AND STRINGER ATTACHMENTS	8
142	LOWER LEFT HAND BS 1440 PRESSURE BULKHEAD	8
189	WING REAR SPAR LEFT HAND TERMINAL FITTING AND BS 820 BULKHEAD	8
27	LOWER BS 360 SKIN PANEL	7
30	BS 360 LAP/BUTT SPLICE SKIN SEGMENT AT S-1	7
37	AFT FUSELAGE SKIN BELOW FORWARD BODY TANK #0	7
52	LOWER CARGO DOOR SILL, BS 515 TO BS 550	7
53	UPPER AFT CORNER, CARGO DOOR OPENING	7
119	SKIN AND SPLICE AT STA 1202 AND S-18	7
149	STA 1505 KEEL STRUCTURE	7
153	LOWER HORIZONTAL STABILIZER CENTER SECTION	7
175	CENTER WING FRONT SPAR AND BS 620 BULKHEAD	7
453		7
	16 Other Sections w/ Count = 6	96
	34 Other Sections w/ Count = 5	170
	31 Other Sections w/ Count = 4	124
	62 Other Sections w/ Count = 3	186
	49 Other Sections w/ Count = 2	98
	30 Other Sections w/ Count = 1	30

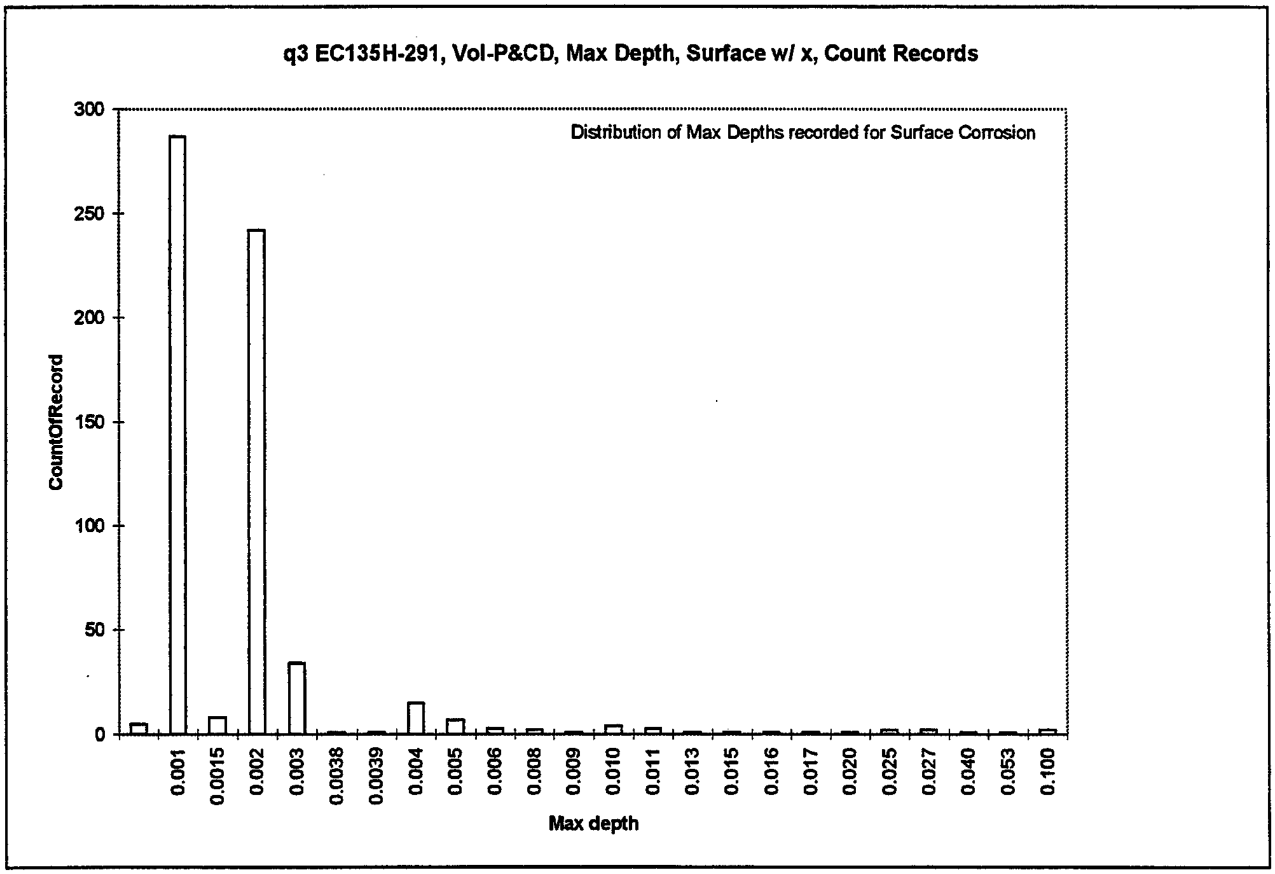


Figure 3.15 EC-135H-291 Tabulated Records Reported in Multiple Volumes Linked to Part & Corrosion Description Records, Count Records by Maximum Measured Corrosion Depth for Surface Corrosion Only.

3.1.3 C/KC-135 Stratotanker - Crack Growth of Selected PSE's with Corrosion

An additional study was performed to estimate the impact of surface corrosion on the structural integrity of selected PSE's of the EC-135H airframe. In Reference [11], the corrosion found on DADTA structure documented by the 291 tear down efforts in References [3-7] was referenced against the DADTA data for the C/KC-135 family of aircraft. From Reference [11], four structural elements were selected for consideration of their structural integrity capability with simulated corrosion. Since this effort is focused on the EC-135H, Section 7 of Reference [12] was used as the source for the DTA analysis details used to support the force structural maintenance plans of the EC-135H. The selected PSE's from Reference [12] are identified in Table 3.8.

This evaluation estimates the impact of a 10% thickness loss (model of severe surface corrosion) to the crack growth life reported in Section 7 of Reference [12]. Since the input information for the reported DTA crack growth estimates is difficult to reproduce, the information below was used for each analysis. Note that the ratio of flights to cycles in the stress spectrum is the same as that used in the NASA MiniTwist spectrum.

- Material crack growth rate data: NASA/NASGRO Ver. 2.0, Al 7178-T6
- Initial analytical crack size: Same as the original DTA estimates as shown in Reference [12] on each page # in Table 3.8
- Stress intensity factor solution: NASA/NASGRO Ver. 2.0, Corner Crack at a hole with a fastener (bearing and by-Pass stresses)
- Stress spectrum: Constant amplitude (1 flight = 15 Cycles = 1hr.)
- Baseline, magnitude selected to yield equivalent life reported in Ref. [12] on each page # in Table 3.8
- Corroded, 10% stress increase over baseline value to model 10% thickness loss

The crack growth results for the four selected structural details are presented in Figures 3.16 through 3.19. Each figure shows crack growth estimates for the "original" and the 10% thickness loss models described above. These estimates are not intended to represent all the details used in the Reference [12] evaluations. These results

represent a relative change in structural integrity capability using simplified crack growth models without and with severe corrosion damage. The estimated reductions in total crack growth life for the four PSE details with simulated severe corrosion damage range from 17% to 24%. These crack growth time reductions would likely be considered unacceptable. Estimated crack growth time reductions for light or moderate corrosion were not estimated and can not be scaled from the above results.

Table 3.8 List of EC-135H Airframe Principal Structural Elements Selected for Consideration of Their DTA Capabilities with Corrosion Damage.

Detail	Description	Reference [12] Page #
W-231-1	wing lower surface spar chord	7.19
W-231-1	wing lower surface spar web	7.19
W-231-9	wing lower skin	7.21
W-231-9	wing lower rear spar chord	7.21

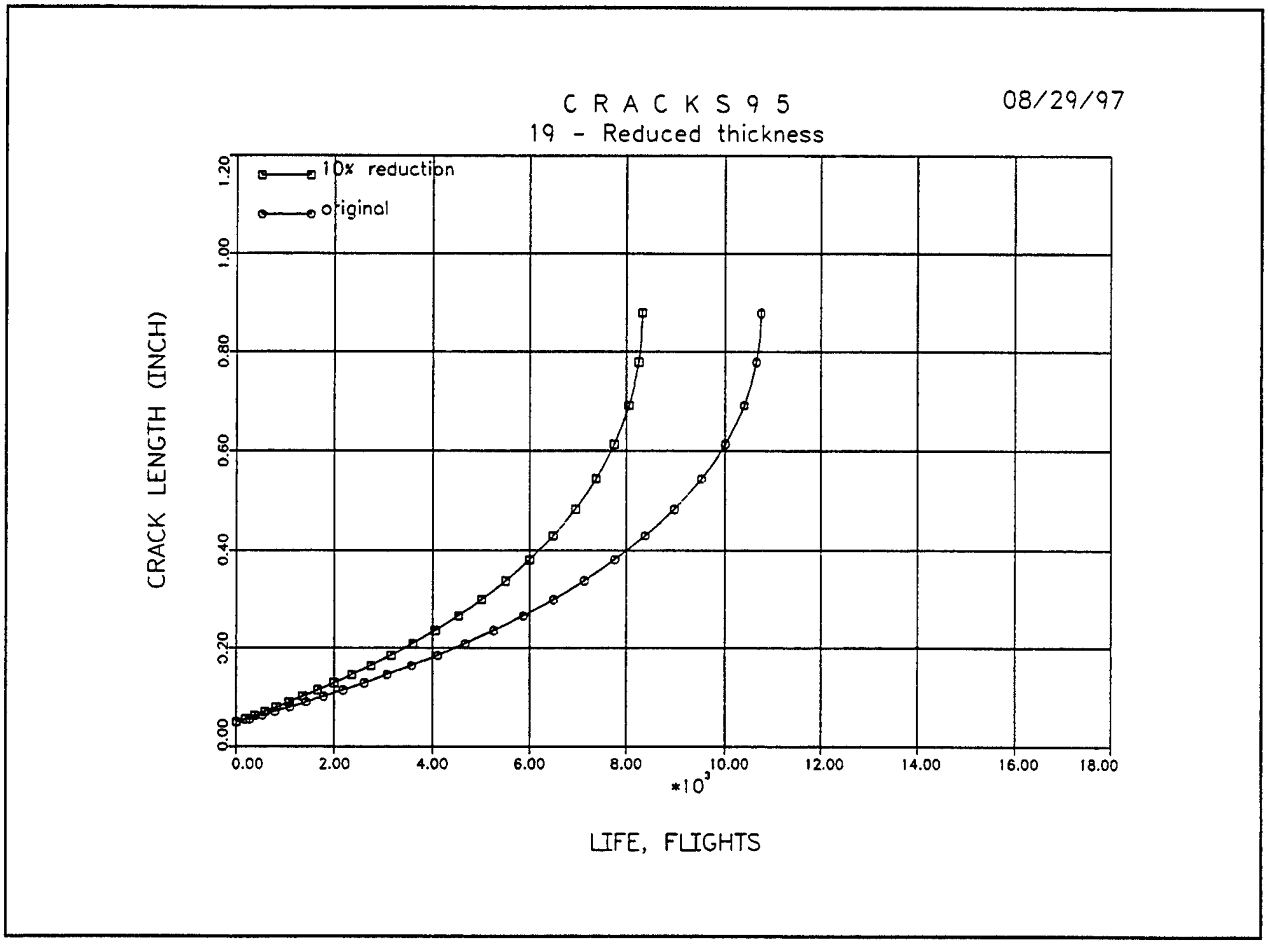


Figure 3.16 Crack Growth Results for Baseline (original) and 10% thickness reduction for Detail: W-231-1, Lower wing surface spar chord (Reference A1.1.1.10, page 7.19).

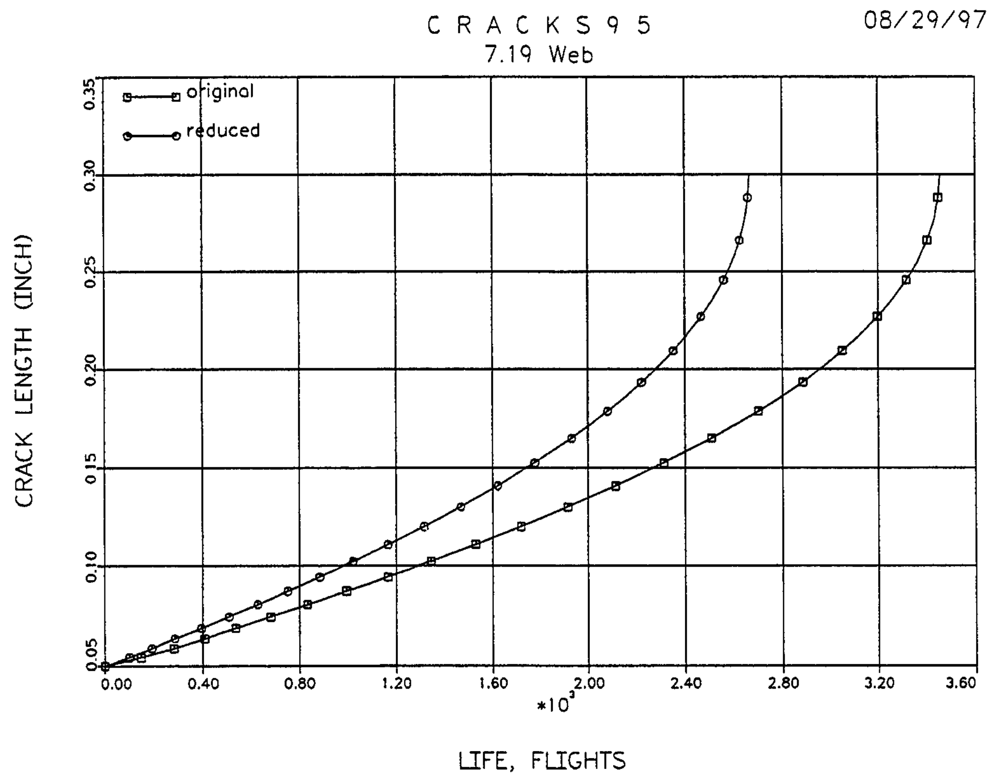


Figure 3.17 Crack Growth Results for Baseline (original) and 10% thickness reduction for Detail: W-231-1, Lower wing surface spar web (Reference A1.1.1.10, page 7.19).

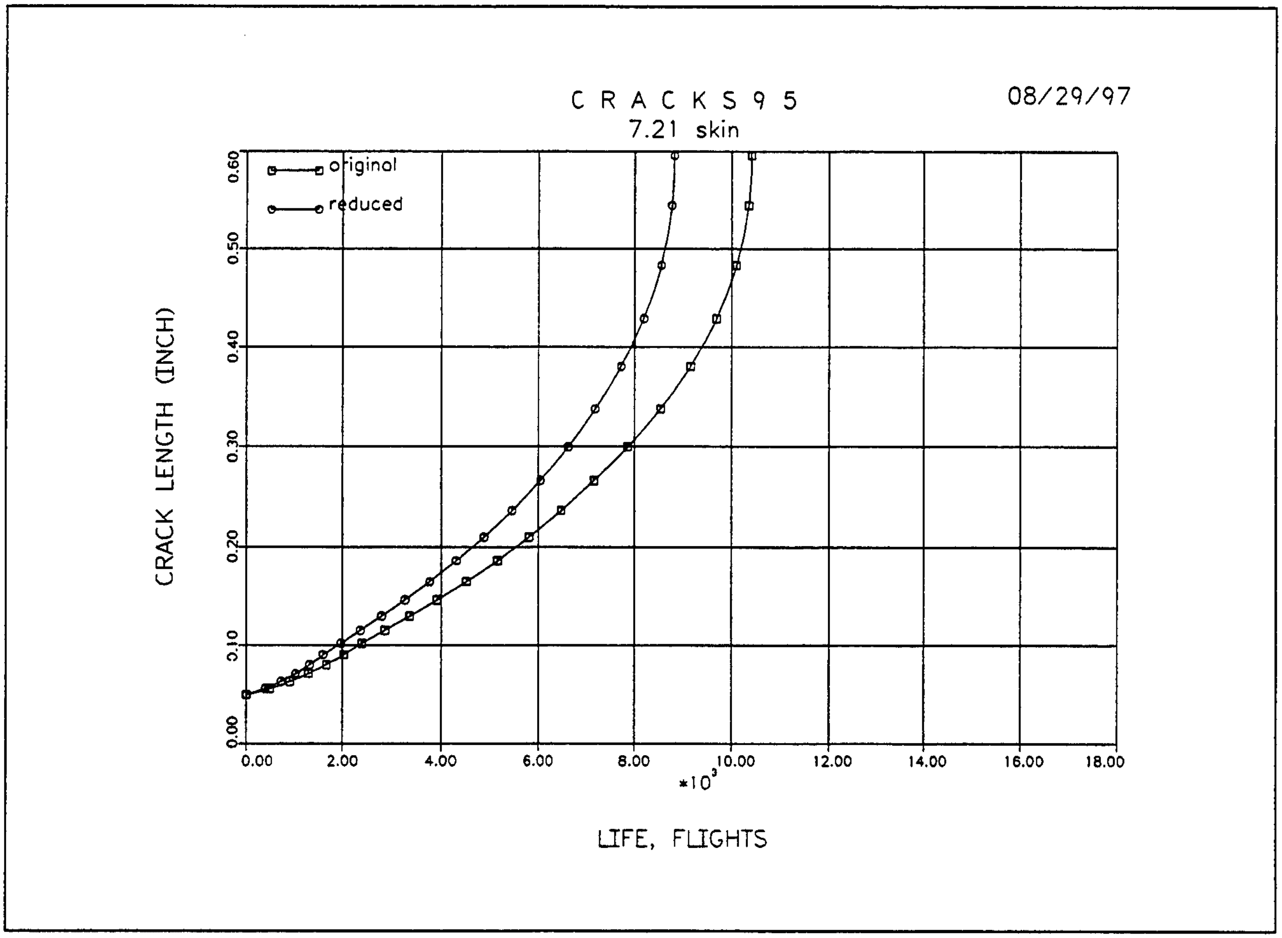


Figure 3.18 Crack Growth Results for Baseline (original) and 10% thickness reduction for Detail: W-231-9, Wing lower skin (Reference A1.1.1.10, page 7.21).

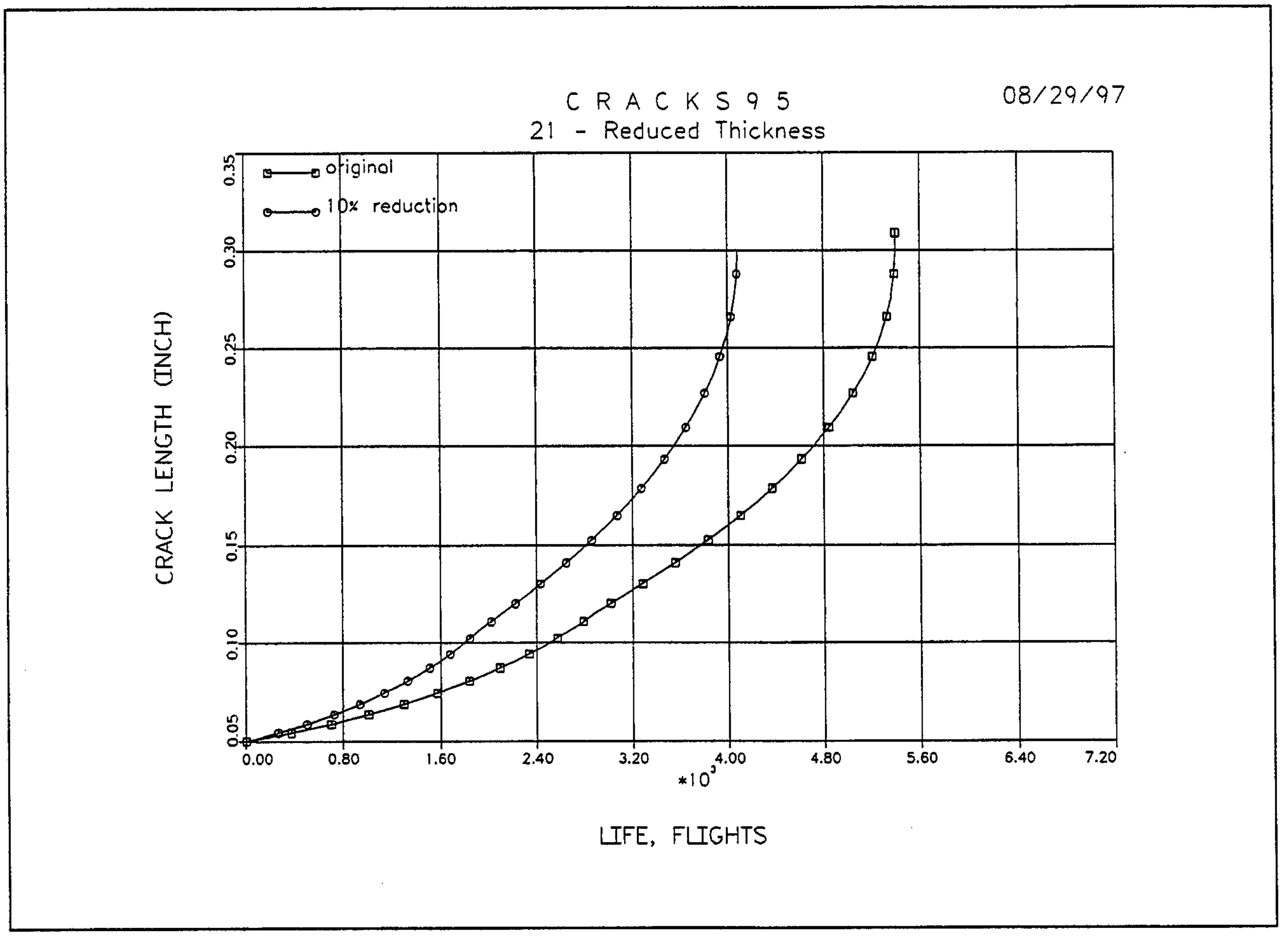


Figure 3.19 Crack Growth Results for Baseline (original) and 10% thickness reduction for Detail: W-231-9, Wing lower rear spar chord (Reference A1.1.1.10, page 7.21).

3.2 E-8C Joint STARS

Two databases were used to estimate the extent of corrosion and cracking for the E-8C Joint STARS fleet of aircraft. First the OACIS database was queried to generate information covering the entire fleet and then the Northrop-Grumman O&A database was queried in an attempt to develop supporting and more detailed data. The following discusses the database queries and the results they indicate. The results are estimates of which principal structural elements (PSEs) are being found with corrosion and fatigue cracking damage.

3.2.1 E-8C Joint STARS - OACIS

Table 3.9 lists all the queries in the E-8C Joint STARS OACIS database (JSOACIS.mdb). Note that the query title in the database appears on each figure or table displaying the query results. The first group of OACIS queries is intended to identify general trends in the data concerning corrosion and cracking. First, the OACIS data base was queried to separate the corrosion and cracking damage records from others contained in the database by counting records grouped by the How Malfunction Code (H/M). The results from this query are presented in Table 3.10. Note that of the 33442 total records in the OACIS database, corrosion and cracking account for 29193 records. In OACIS, corrosion is recorded as severe (H/M=667) or mild (H/M=170) while the cracking group (H/M=190) has no associated degree of damage. Of the 29193 records, 72% are attributed to mild corrosion while records attributed to cracking are the smallest group at 2%.

Next, a query was performed that counted records grouped by Tail number where the H/M codes are corroded (667 or 170) or cracked (170). The Pareto trend from the query of records by tail number is presented in Figure 3.20. This trend identifies the top tail numbers that have experienced the most repairs for corrosion or cracking. The JSTARS Aircraft Information table in the E-8C JSTARS OACIS database will provide additional information concerning the identification and history of the listed tail numbers. For example, the tail number with the highest record count (19622), aircraft P1, was manufactured in 1967, and was furnished to the USAF Joint Stars

program in 1992. Note that all the aircraft have a negligible number of records attributed to cracking. For each the first two tail numbers, the percentage of severe corrosion records is much less than the mild corrosion record counts. However, each of the next four tail numbers, the fraction of severe corrosion records is at least half the total record counts. This trend information could be useful in other efforts to identify unique characteristics of these aircraft that may have driven the displayed corrosion occurrences (i.e. usage, location, and cargo type).

Next, two queries were performed which counted records by work area (W/A) and work zone (W/Z) where the How-Malfunction code was limited to severe corrosion, mild corrosion, and cracking (H/M = 667, 170, & 190 respectively). The W/A code is a specific location on the airframe where inspection and repair work is performed. The W/Z is a smaller area within each W/A. These Pareto trends grouped by W/A and W/Z appear in Figures 3.21 and 3.22 respectively. Note that the work areas and work zones, which are displayed in these figures, are not the same as those defined in Table 2.10. It seems that OACIS uses a work zone that is likely what appears in Table 2.10 as work area. The definition of what OACIS uses as work area was unavailable in this effort. The results show that the OACIS work areas with the top two record counts (W/A = 8206 and 8202) are about 5 times greater than the next highest work area. The work zones with the highest record counts are the zones grouped as "1-" which are the sections in the lower half of the fuselage (using Table 2.10). The discrepancy that exists between the work area and work zone definitions should be further evaluated.

Regardless of the definitions of the OACIS work areas, a query was performed that grouped the corroded and cracked records by work zones where the work areas were limited to 8206 and 8202. The Pareto trends of work zone for W/A 8202 and 8206 are displayed in Figures 3.23 and 3.24 respectively. Again the "1-" work zones are the high record counts for W/A = 8202 while a mix of zones are the high record counts for W/A = 8206.

The next set of OACIS queries is intended to identify specific PSEs with higher occurrences of corrosion and cracking records. Several queries were performed that counted records grouped by a selected PSE key word where the H/M code is 667, 170, and 190 (corrosion and cracking). Each query counted records where a selected key

word occurred in the OACIS text field describing the discrepancy. The initial list of PSE key words is identified in Figure 3.1. Several queries and manual reviews of individual records were performed to select the final list of key words. The Pareto trend from these queries is listed in Table 3.12 and identifies "skin" structural elements with the highest record counts. The "skin" structural elements account for about 40% (4118) of the total records counted by a PSE key word (10140) with mild corrosion being the majority of those (3366).

Note that from the above summary of OACIS records counted by a PSE key word that there is a large amount of data not represented. That is, 33442 repair records were attributed to damage caused by corrosion and cracking while only 10140 repair records (30%) were counted by the PSE key words listed in Table 3.12. To better identify and rank PSE key words with corrosion or cracking damage, a series of queries could be performed searching for records with a broader selection of PSE key words.

The location of the damaged PSEs identified in Table 3.12 can also be determined by a cross-tab query on work area and work zone. That is, count records grouped by work area (W/A) where the PSE key word in the discrepancy text field is (for example) "skin" and the H/M code is 667, 170, and 190. The results from this query are presented in Table 3.13 and show that again W/A = 8206 and 8202 have record counts about 5 times greater than the next work area. Next, a query was performed which counted records by W/Z where the W/A is 8202 and 8206, the PSE key word is "skin", and the H/M code is 667, 170, and 190. The Pareto trends from this query for the two work areas are presented in Figures 3.25 and 3.26. For "skin" PSEs in work area 8202 (using Table 2.10), the top five work zones are all fuselage locations with the top two work zones being the aft fuselage. For "skin" PSEs in work area 8206 (using Table 2.10), the top five work zone locations are the main and tail wing.

The final set of OACIS queries is intended to find a common ground or trend with the Northrop-Grumman O&A database. A query was performed that counted records by work zone where the aircraft ID is P3 and P4 (the two aircraft reviewed by Northrop-Grumman) and the H/M code is 667, 170, and 190. The trends from this query are shown in Figure 3.27 and yield similar results as shown in Figure 3.22. This trend will again be discussed in the following section. However, note that the OACIS data yields

4963 records for the P3 and P4 aircraft while the Northrop-Grumman O&A database contains only 1536 records.

Clearly cracking is not a high driver of repairs for the E-8C fleet. Mild corrosion accounts for the large majority of repairs on the fleet. However, 2 of the 8 aircraft account for half of the mild corrosion. Four aircraft have about a 50/50 mix of mild and severe corrosion damage. Again, "skin" PSEs are the majority of structural elements found with corrosion damage. The "skin" damage occurs slightly more often in the fuselage than in the wings.

Table 3.9 List of Queries in the E-8C OACIS Access Database (JSOACIS.Mdb).

Name of Queries in JSOACIS.mdb
J* OACIS, How Mal, Count Records
J* OACIS, Tail #, 667&170&190, Count Records
J* OACIS, Tail #, 667&170&190, Ct Rec. w/ Discrep *angle*
J* OACIS, Tail #, 667&170&190, Ct Rec. w/ Discrep *beam*
J* OACIS, Tail #, 667&170&190, Ct Rec. w/ Discrep *bulk*
J* OACIS, Tail #, 667&170&190, Ct Rec. w/ Discrep *frame*
J* OACIS, Tail #, 667&170&190, Ct Rec. w/ Discrep *rib*
J* OACIS, Tail #, 667&170&190, Ct Rec. w/ Discrep *skin
J* OACIS, Tail #, 667&170&190, Ct Rec. w/ Discrep *stringer*
J* OACIS, W/A 8202/6, Z, 667&170&190, Ct Rec. w/ Discrep *skin*
J* OACIS, W/A 8202/6, Z, 667&170&190, Tail #, Discrep w/ *skin*
J* OACIS, Work Area 8202/6, Tail #, 667&170&190, Count Records
J* OACIS, Work Area 8202/6, Zone, 667&170&190, Count Records
J* OACIS, Work Area 8202/6, Zone, 667&170&190, Discrepancy
J* OACIS, Work Area, 667&170&190, Count Records
J* OACIS, Work Area, 667&170&190, Ct Rec. w/ Discrep *angle*
J* OACIS, Work Area, 667&170&190, Ct Rec. w/ Discrep *beam*
J* OACIS, Work Area, 667&170&190, Ct Rec. w/ Discrep *bulk*
J* OACIS, Work Area, 667&170&190, Ct Rec. w/ Discrep *frame*
J* OACIS, Work Area, 667&170&190, Ct Rec. w/ Discrep *rib*
J* OACIS, Work Area, 667&170&190, Ct Rec. w/ Discrep *skin*
J* OACIS, Work Area, 667&170&190, Ct Rec. w/ Discrep *stringer*
J* OACIS, Work Area, 667&170&190, Discrepancy like *?*
J* OACIS, Zone, 667&170&190, Count Records
J* OACIS, Zone, 667&170&190, P3&P4, Count Records

Table 3.10 E-8C OACIS, JSOACIS, Count Records by How Malfunction Code (How Mal).

J* OACIS, How Mal, Count Records

Sum 33442

How Mal Code	Description	CountOfRecord
170	Corroded Mild/Moderate	21038
667	Corroded Severe	7598
0		928
190	Cracked	557
425		512
553	Does not meet specifications	465
20	Worn, Chaffed, frayed, or torn	449
844		424
780		227
105	Loose, damaged, or missing hardware	198
804		159
865	Deteriorated	145
70	Broken	143
86		104
710	Bearing failure	70
917		50
750		49
846	Delaminated	37
127		21
116		16
135		14
230		12
120		12
677		11
730		10
799		10
843		10
561		8
67		7
669		7
176		6
800		6
178		6
801		5
381		5
179		4
180		4
17		4
107		4
110		4
664		4
Other Codes w/ count < 4 each		99

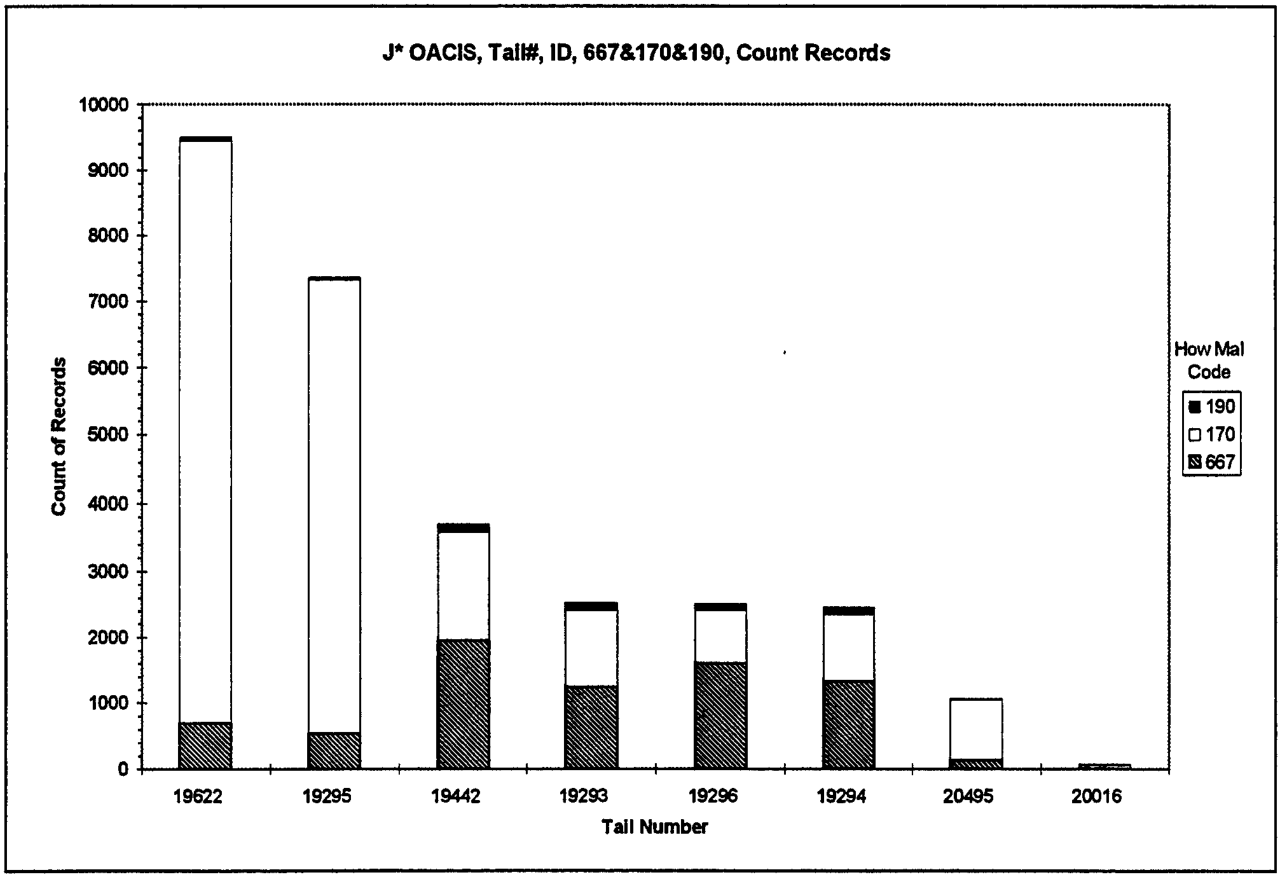


Figure 3.20 E-8C OACIS, JSOACIS, Count Records by Aircraft Tail Number where the How Malfunction (How Mal) Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), and 190 (Cracked).

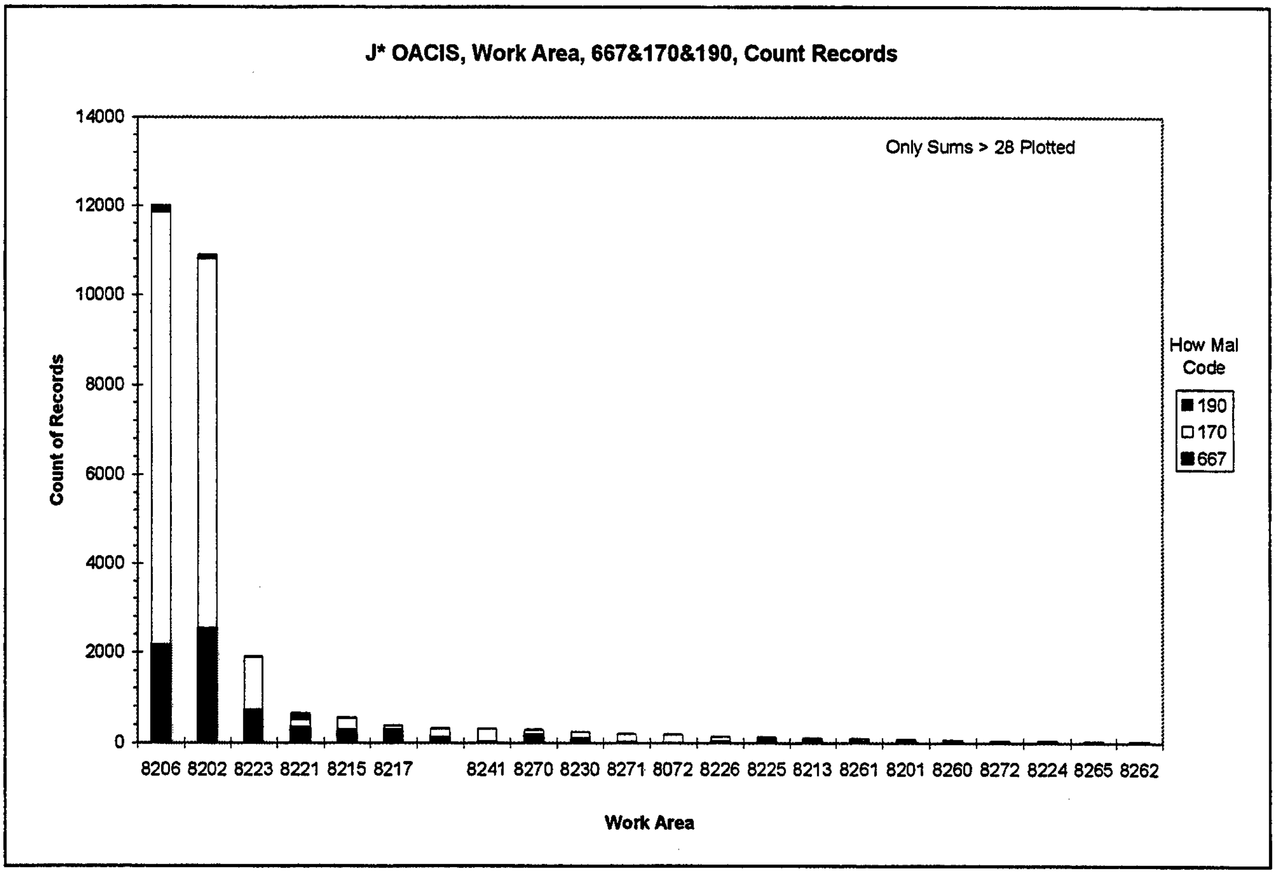


Figure 3.21 E-8C OACIS, JSOACIS, Count Records by Work Area Code where the How Malfunction (How Mal) Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), and 190 (Cracked).

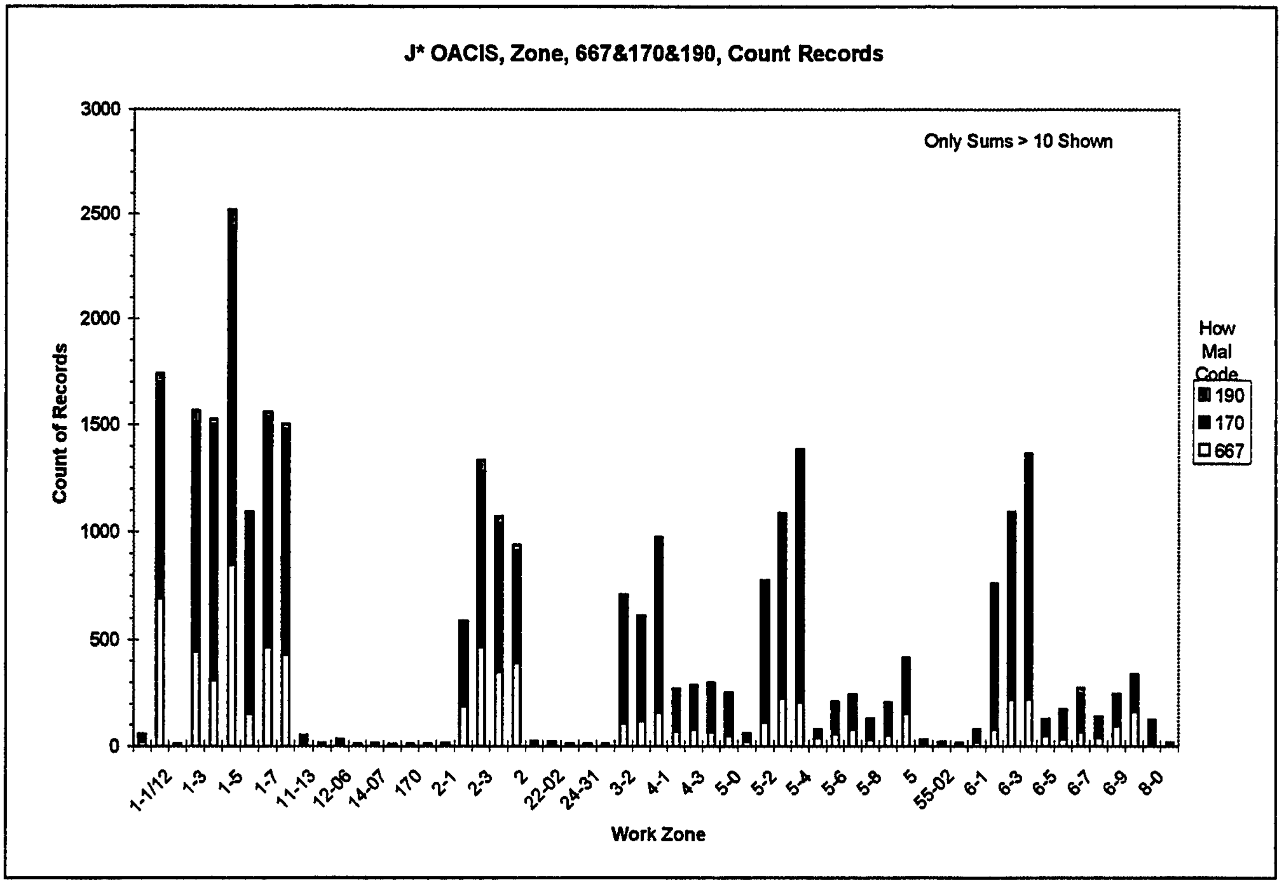


Figure 3.22 E-8C OACIS, JSOACIS, Count Records by Work Zone Code where the How Malfunction (How Mal) Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), and 190 (Cracked).

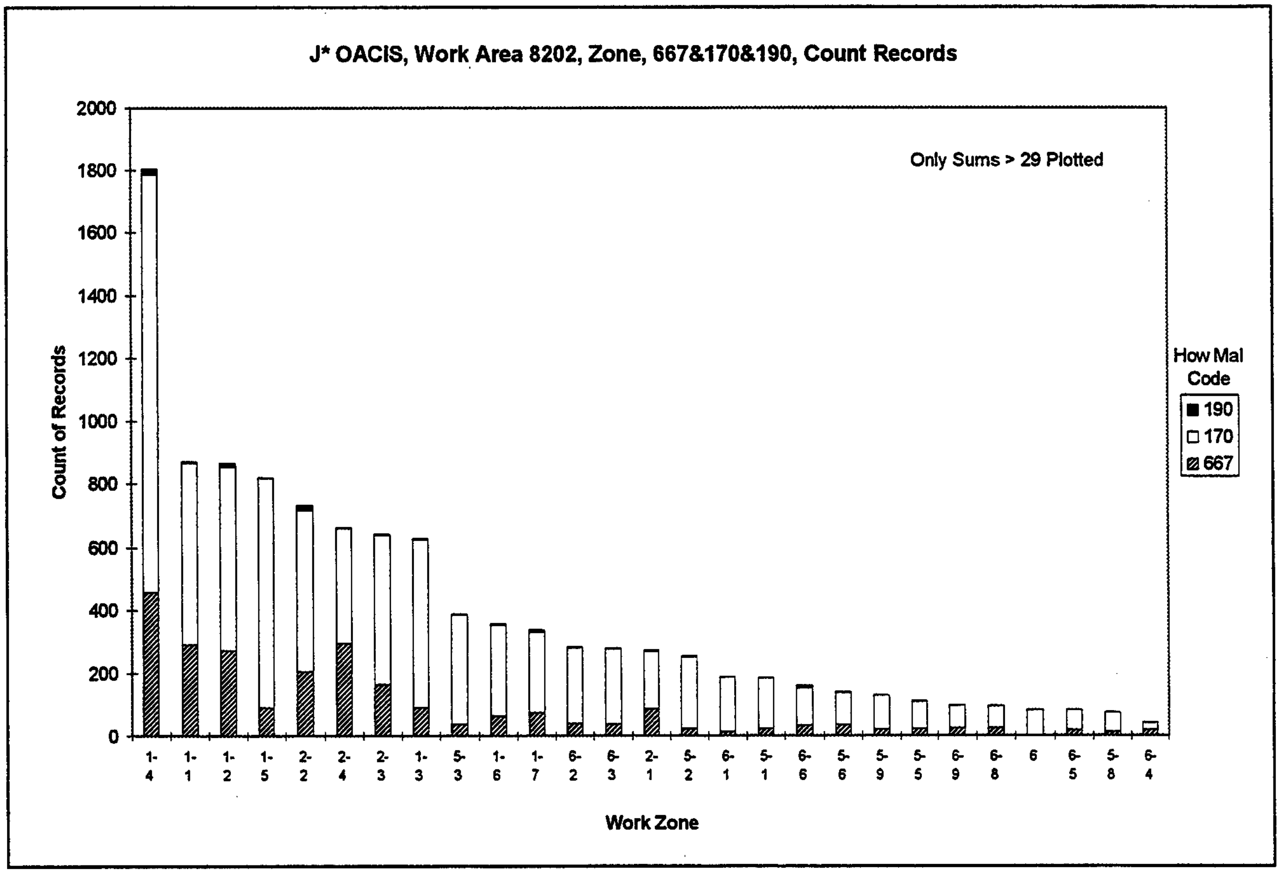


Figure 3.23 E-8C OACIS, JSOACIS, Count Records by Work Zone Code where the Work Area Code = 8202 and where the How Malfunction (How Mal) Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), and 190 (Cracked).

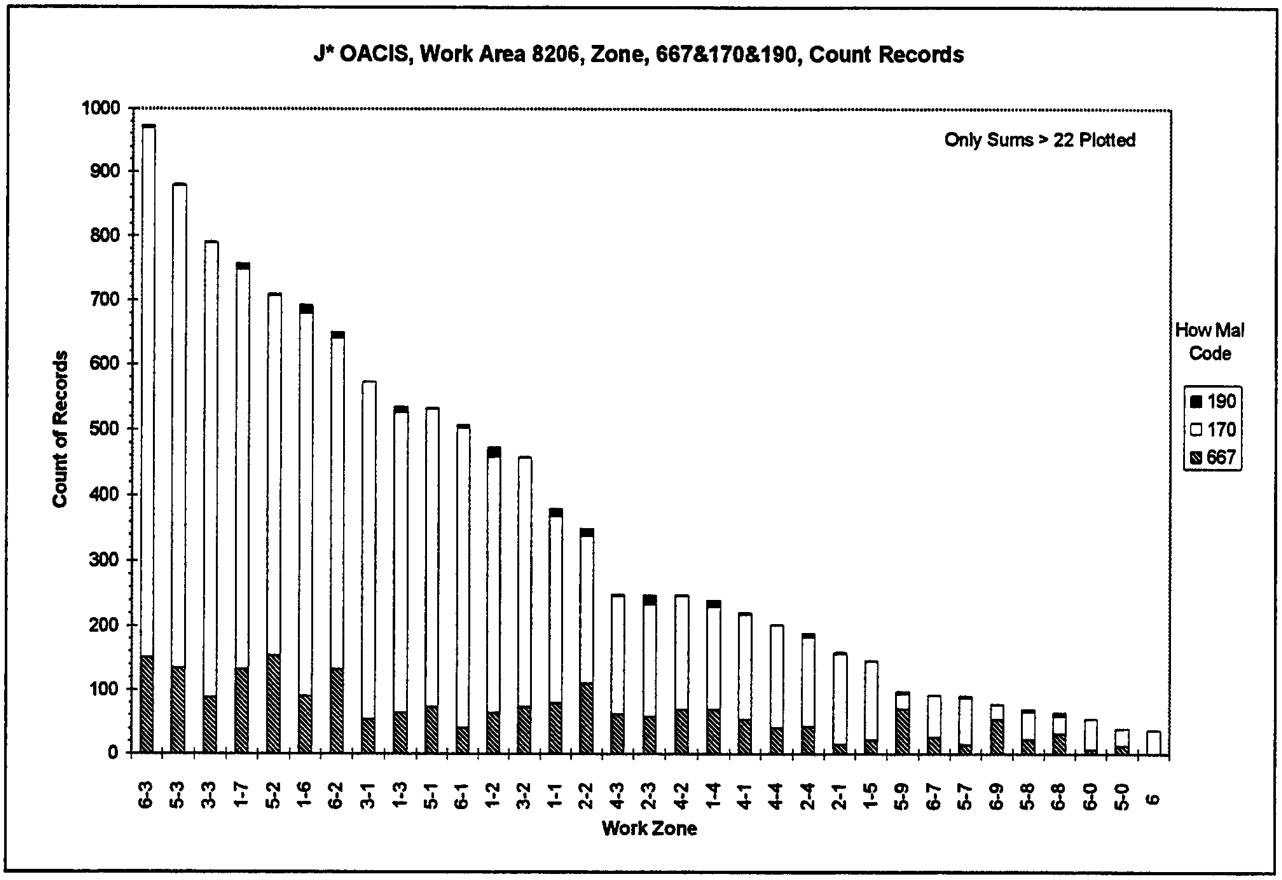


Figure 3.24 E-8C OACIS, JSOACIS, Count Records by Work Zone Code where the Work Area Code = 8206 and where the How Malfunction (How Mal) Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), and 190 (Cracked).

Table 3.11 E-8C OACIS, JSOACIS, Count Records by Tail Number where the Work Area Code = 8202 & 8206 and where the How Malfunction (How Mal) Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), and 190 (Cracked).

J* OACIS, Work Area 8202, Tail#, 667&170&190, Count Records

		How Mal Code Count of Records			
Sum		2546	8249	100	10895
Work Area	Tail Number	667	170	190	Sum
8202	19295	349	3363	19	3731
8202	19622	420	3224	32	3676
8202	19442	741	460	24	1225
8202	19294	407	454	5	866
8202	19296	410	315	13	738
8202	19293	219	433	7	659

J* OACIS, Work Area 8206, Tail#, 667&170&190, Count Records

		How Mal Code Count of Records			
		2172	9677	167	12016
Work Area	Tail Number	667	170	190	Sum
8206	19622	261	5296	20	5577
8206	19295	180	3364	19	3563
8206	19294	510	379	43	932
8206	19296	589	212	30	831
8206	19442	290	230	42	562
8206	19293	325	156	12	493
8206	20495	17	40	1	58

Table 2.12 E-8C OACIS, JSOACIS, Count Records by Structural Element Key Word in the Discrepancy Description where the How Malfunction (How Mal) Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), and 190 (Cracked).

J* OACIS, 667&170&190, Ct Rec w/ Discrep *?*

Sum	3069	6917	154	10140
	How Mal Code			
	Count of Records			
Discrepancy w/	667	170	190	Sum
skin	719	3366	33	4118
rib	371	1076	7	1454
frame	524	621	20	1165
beam	309	765	8	1082
stringer	276	760	14	1050
angle	831	116	71	1018
bulk	39	213	1	253

Table 3.13 E-8C OACIS, JSOACIS, Count Records by Work Area Code where the Structural Element Key Word = "skin" in the Discrepancy Description and where the How Malfunction (How Mal) Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), and 190 (Cracked).

J* OACIS, Work Area, 667&170&190, Ct Rec w/ Discrep *skin*

Sum	719	3366	33	4118

How Mal Code
Count of Records

Work Area	667	170	190	Sum
8206	311	1410	12	1733
8202	215	1495	15	1725
8223	97	151	2	250
8072	3	95		98
8215	17	65		82
8270	4	24		28
8226	3	23		26
8271	4	22		26
8217	16	4	2	22
8230	9	13		22
8241	5	16		21
8213	14	5		19
	3	11		14
8261	1	11	1	13
8225	5	1		6
8076		3		3
8201		3		3
8204	1	2		3
026		2		2
8221	1	1		2
8240	2			2
8264	2			2
8276		2		2
001	1			1
024	1			1
8071		1		1
8200	1			1
8203		1		1
82096		1		1
8231		1		1
8233		1		1
8250			1	1
826	1			1
8265	1			1
8267	1			1
8272		1		1
8726		1		1

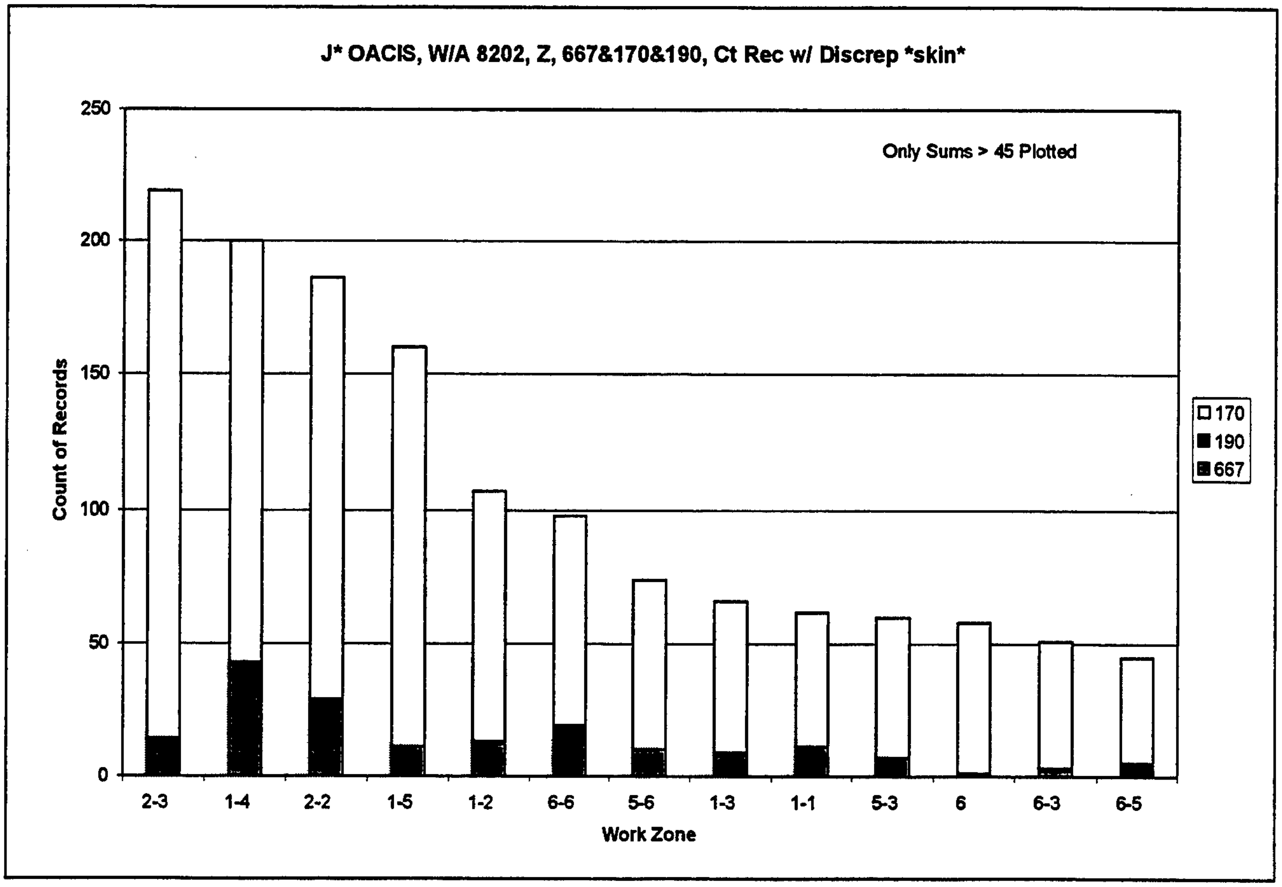


Figure 3.25 E-8C OACIS, JSOACIS, Count Records by Work Zone Code where the Work Area Code = 8202, the Structural Element Key Word = "skin" in the Discrepancy Description and the How Malfunction (How Mal) Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), and 190 (Cracked).

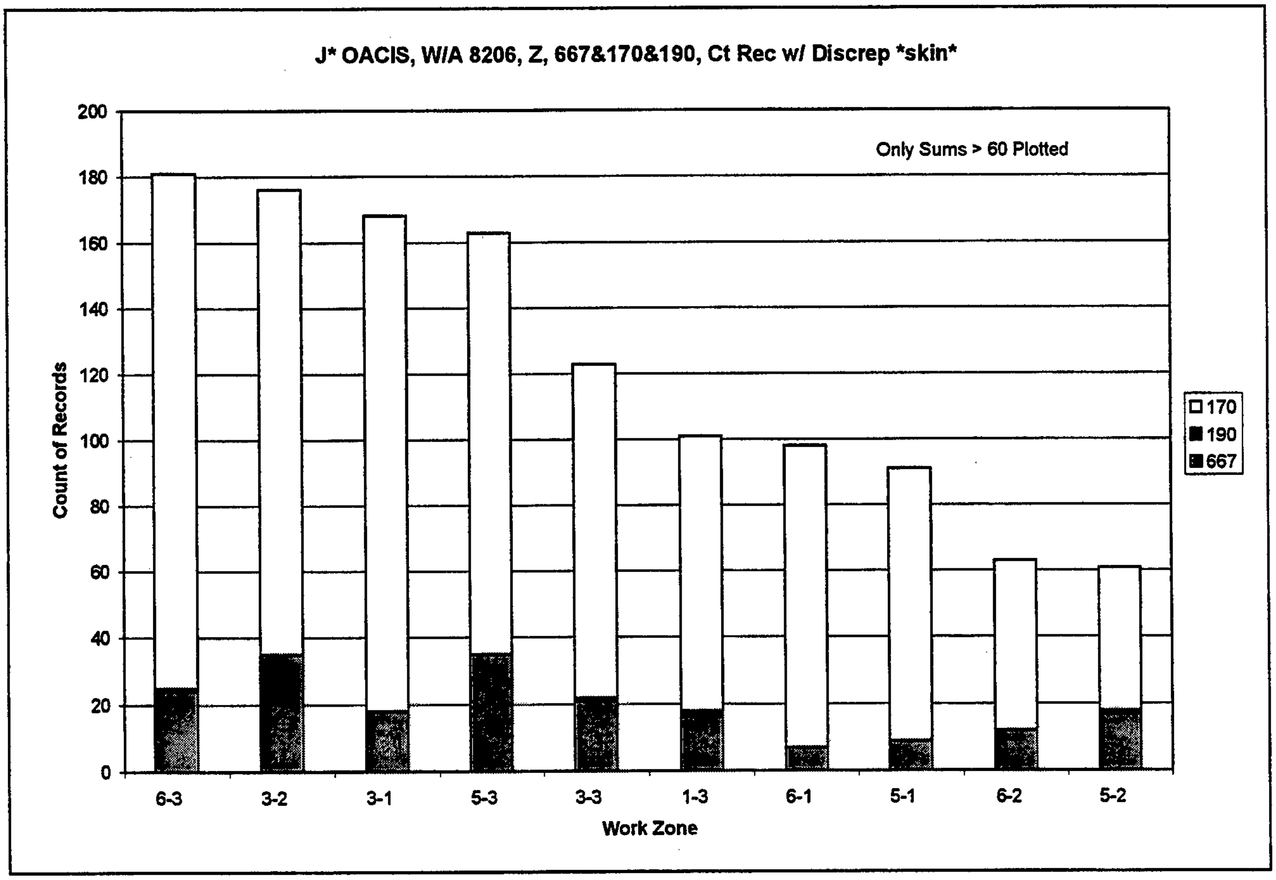


Figure 3.26 E-8C OACIS, JSOACIS, Count Records by Work Zone Code where the Work Area Code = 8206, the Structural Element Key Word = "skin" in the Discrepancy Description and the How Malfunction (How Mal) Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), and 190 (Cracked).

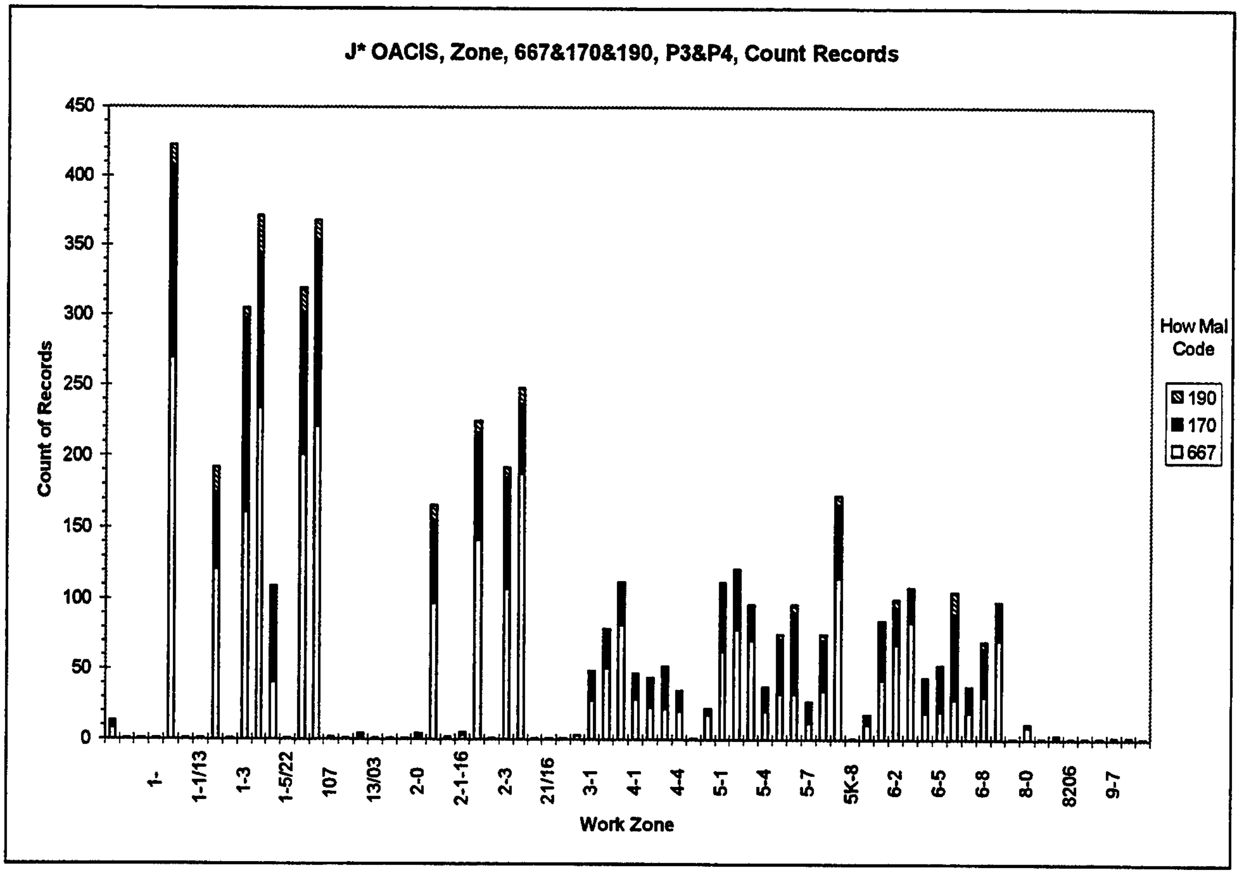


Figure 3.27 E-8C OACIS, JSOACIS, Count Records by Work Zone Code where the Aircraft ID is P3 & P4 and the How Malfunction (How Mal) Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), and 190 (Cracked).

3.2.2 E-8C Joint STARS, Northrop-Grumman Over & Above

Table 3.14 lists all the queries in the E-8C Joint Stars Northrop-Grumman Over & Above database (JSTARSNG3.mdb). Note that the query title in the database appears on each figure or table displaying the query results. These records are a selected set of repair records for the P3 and P4 aircraft found by Northrop-Grumman to have notable (by location or type) corrosion and cracking damage. The information developed by Northrop-Grumman from their database is documented in Reference [19]. Since the database used by Northrop-Grumman is the same as that supplied for this program, the first group of queries is in part intended to verify some of the trends reported in Reference [19].

First, a query was performed that counted records grouped by aircraft work zone while linked to the work zone description table. These query results are presented in Table 3.15 and shows that of the 1536 total records 1147 are for fuselage work zones while only 265 are for main wing work zones. The remaining records are for the tail control surfaces and the engine pylons. The next six queries will each result in the same record count totals for each work zone as shown in Table 3.15 but, in addition they will be cross-tabbed by defect type, aircraft ID, How-Malfunction code, PSE – yes/no, material type, and material part form. This series of queries allows the relative amounts of each cross-tabbed item to be viewed. These cross-tabbed groupings are more detailed then that listed in Reference [19].

Figure 3.28 presents the records cross-tabbed by defect type, which can be directly compared to Figure 4.1 in Reference [19]. The defect type groups were defined by Northrop-Grumman and fully described in Reference [19]. The defect types with the top three record counts are corrosion (CN, 1011 records), crack (CK, 227 records), and Corrosion induced by exfoliation (CNF, 175 records). The trends are comparable for most work zones although not exact (as should be expected). For example, Reference [19] reports zone 1-1 to have about 238 records versus the 218 records shown in Figure 3.28. However, there is one group, work zone 2-4, where the record counts are not comparable. The results from the Northrop-Grumman O&A database used in this program identify only 82 total records for work zone 2-4 while Figure 4.1 from Reference

[19] indicates approximately 270 records (the highest count for all zones). It is noted that the sum of all records that is shown in Figure 4.1 of Reference [19] is approximately 1750 records versus the 1536 total records available in the Northrop-Grumman O&A database. This difference could impact the conclusions reported in Reference [19] unless Northrop-Grumman added more records to their database after being delivered for this program.

The differences discussed above are also present in the next 5 queries crossed-tabbed by various groupings. Figures 3.29 counted records grouped by work zone while cross-tabbed by the two aircraft reviewed (P3 and P4). Records counted for the P3 aircraft totaled 925 while records for the P4 aircraft totaled 611. This query trend is intended to be comparable with Figures 4.2 and 4.3 of Reference [19]. Figure 3.30 shows record counts crossed-tabbed by How-Malfunction (H/M) codes which for this database includes only 667 (severe corrosion), 170 (mild corrosion), and 190 (cracking). The H/M codes with the top three record counts are 170, 667, and 190 with 632, 626, and 227 records respectively. Very comparable trends with that shown in Figure 3.29. Figure 3.31 shows records counts cross-tabbed by the PSE – yes/no indicator. Most of the records seem to be mostly for non-PSE structure. Figure 3.32 shows records counts cross-tabbed by material alloy designation. The largest count of records is for the "N/A" group (not available) followed by 7075-T6 and 2024-T3 (as expected). Figure 3.33 shows records crossed-tabbed by the material processing form of the part. The largest count of records is for the "N/A" group (not available) followed by sheet (clad) and plate (also as expected).

All six of the trends discussed above present a consistent set of results. That is, corrosion records, while split about 50/50 between severe and mild corrosion, occur more than 5 times more often than the cracking records. Plus, the corrosion and cracking damage found on secondary structure occurs about 4 times more often the on principal structural elements (PSEs).

The next series of Northrop-Grumman O&A database queries is intended to provide further support of the OACIS query results in Section 3.2.1 and to provide added detail. The queries are intended to identify specific PSEs and locations with the higher occurrences of corrosion and cracking records.

Table 3.16 presents the results of a query that counted records grouped by work zone for a selected list of station locations. The station locations selected are those where the major assembly sections are joined together for the body and wings. Figure 2.1 illustrates the major assembly sections and the locations where they are joined. For the airframe body, the major assembly join locations are BS 304, 360, 600, 820, 960, and 1440. For the wings, the major assembly join locations are WS 360 and 733. This query identified 22% of the total records counted (339) as occurring at these eight critical airframe assembly join locations. Corrosion record counts exceeded cracking records by more than a factor of 5 and BS 600 has the highest record count of 100. These results indicate that some of the most critical structural elements (i.e. the structure which joins major assemblies) are not a majority of structural elements found with corrosion or cracking.

Next, several queries were performed that counted records with the occurrence of a selected key word that is included in Nomenclature field of the Northrop-Grumman O&A database. The Pareto trend developed from the results of all these queries is shown in Figure 3.34. Table 3.17 also lists the query results and identifies 30% (the largest group) of the records counted as "skin" PSEs (listed as skin, panel, or plank). Several queries were then performed to identify the location of the damage found on the PSEs identified in Table 3.17. Table 3.18 lists the work zone locations for the PSEs identified as "skin", "panel", or "plank". Note that the "plank" PSEs are all wing locations and account for 132 records. The "skin or panel" PSEs are all fuselage body locations and if grouped by the lower and upper body locations account for 136 and 96 records respectively.

Clearly cracking is not a high driver of repairs for these two aircraft. Corrosion damage occurs more than 5 time more often than cracking damage. Skin PSEs are the largest group of structural elements found with corrosion or cracking damage. The majority of the damaged skins are located in the fuselage. In general, these results support those generated from the OACIS database queries.

Table 3.14 List of Queries in the Northrop-Grumman E-8C Joint STARS Over & Above Access Database (JSTARNG3.mdb)

JSTARNG3.mdb Queries of Data Tables
J* O&A, Nomenclature, count records
J* O&A, Zone, A/C ID, count records
J* O&A, Zone, count records
J* O&A, Zone, Defect, BS like *1440*, count records
J* O&A, Zone, Defect, BS like *304*, count records
J* O&A, Zone, Defect, BS like *360*, count records
J* O&A, Zone, Defect, BS like *600*, count records
J* O&A, Zone, Defect, BS like *820*, count records
J* O&A, Zone, Defect, BS like *960*, count records
J* O&A, Zone, Defect, Nomen like *angle*, count records
J* O&A, Zone, Defect, Nomen like *beam*, count records
J* O&A, Zone, Defect, Nomen like *bulk*, count records
J* O&A, Zone, Defect, Nomen like *cost*, count records
J* O&A, Zone, Defect, Nomen like *frame*, count records
J* O&A, Zone, Defect, Nomen like *plank*, count records
J* O&A, Zone, Defect, Nomen like *rib*, count records
J* O&A, Zone, Defect, Nomen like *skin*, count records
J* O&A, Zone, Defect, Nomen like *stringer*, count records
J* O&A, Zone, Defect, Nomen like *web*, count records
J* O&A, Zone, Defect, WS like *360*, count records
J* O&A, Zone, Defect, WS like *733*, count records
J* O&A, Zone, Defect, WS like *960*, count records
J* O&A, Zone, H/M, count records
J* O&A, Zone, Material, count records
J* O&A, Zone, Part Form, count records
J* O&A, Zone, PSE (1,0), count records

Table 3.15 Northrop-Grumman E-8C JSTARS O&A, Count Records Grouped by Aircraft Work Zone Location Linked to Work Zone Description Table.

J* O&A, Zone, count records

Sum = 1536

AIRCRAFT ZONE	CountOfRecord	Major Zone Primary Description	Major Zone Secondary Description	Loc From:	Loc To:
1-1	218	Lower Fuselege structure (below floor)	Nose and Nose Gear support structure	BS 178	BS 360
1-2	85	Lower Fuselege structure (below floor)	Section forward of wing box aft of nose gear	BS 360	BS 600
1-3	101	Lower Fuselege structure (below floor)	Wing Box and center wing cavity	BS 600	BS 960
1-4	174	Lower Fuselege structure (below floor)	Section Aft of Main Gear to aft pressure bulkhead	BS 960	BS 1440
1-5	77	Lower Fuselege structure (below floor)	Tail Cone	BS 1440	BS 1675
1-6	64	Lower Fuselege structure (below floor)	Left main gear support structure	BS 820	BS 960
1-7	85	Lower Fuselege structure (below floor)	Right main gear support structure	BS 820	BS 960
2-1	80	Upper Fuseloge structure (above floor)	Cockpit	BS 178	BS 304
2-2	105	Upper Fuseloge structure (above floor)	Section from cockpit to aft of the wing box	BS 304	BS 820
2-3	76	Upper Fuseloge structure (above floor)	Section from wing box to aft pressure bulkhead	BS 820	BS 1440
2-4	82	Floor Beams and Seat Tracks	Floor Beams and Seat Tracks		
3-1	34	Fin and Horizontal Stabilizer	Left Horizontal Stabilizer		
3-2	40	Fin and Horizontal Stabilizer	Right Horizontal Stabilizer		
3-3	17	Fin and Horizontal Stabilizer	Fin		
4-1	6	Engine Pylon Structure	Left outboard	WS 733	
4-2	5	Engine Pylon Structure	Left Inboard	WS 360	
4-3	13	Engine Pylon Structure	Right Inboard	WS 733	
4-4	9	Engine Pylon Structure	Right Outboard	WS 360	
5-3	4	Left Wing and Control Surfaces	Inboard wing LE	WS 360	WS 0
5-4	4	Left Wing and Control Surfaces	Outboard wing beams and skins	WS 960	WS 733
5-5	46	Left Wing and Control Surfaces	Middle wing beams and skins	WS 733	WS 360
5-6	48	Left Wing and Control Surfaces	Inboard wing beams and skins	WS 360	WS 0
5-8	4	Left Wing and Control Surfaces	Middle wing TE flaps	WS 733	WS 360
5-9	36	Left Wing and Control Surfaces	Inboard wing TE flaps	WS 360	WS 0
6-0	1				
6-4	4	Right Wing and Control Surfaces	Outboard wing beams and skins	WS 960	WS 733
6-5	34	Right Wing and Control Surfaces	Middle wing beams and skins	WS 733	WS 360
6-6	68	Right Wing and Control Surfaces	Inboard wing beams and skins	WS 360	WS 0
6-8	9	Right Wing and Control Surfaces	Middle wing TE flaps	WS 733	WS 360
6-9	7	Right Wing and Control Surfaces	Inboard wing TE flaps	WS 360	WS 0

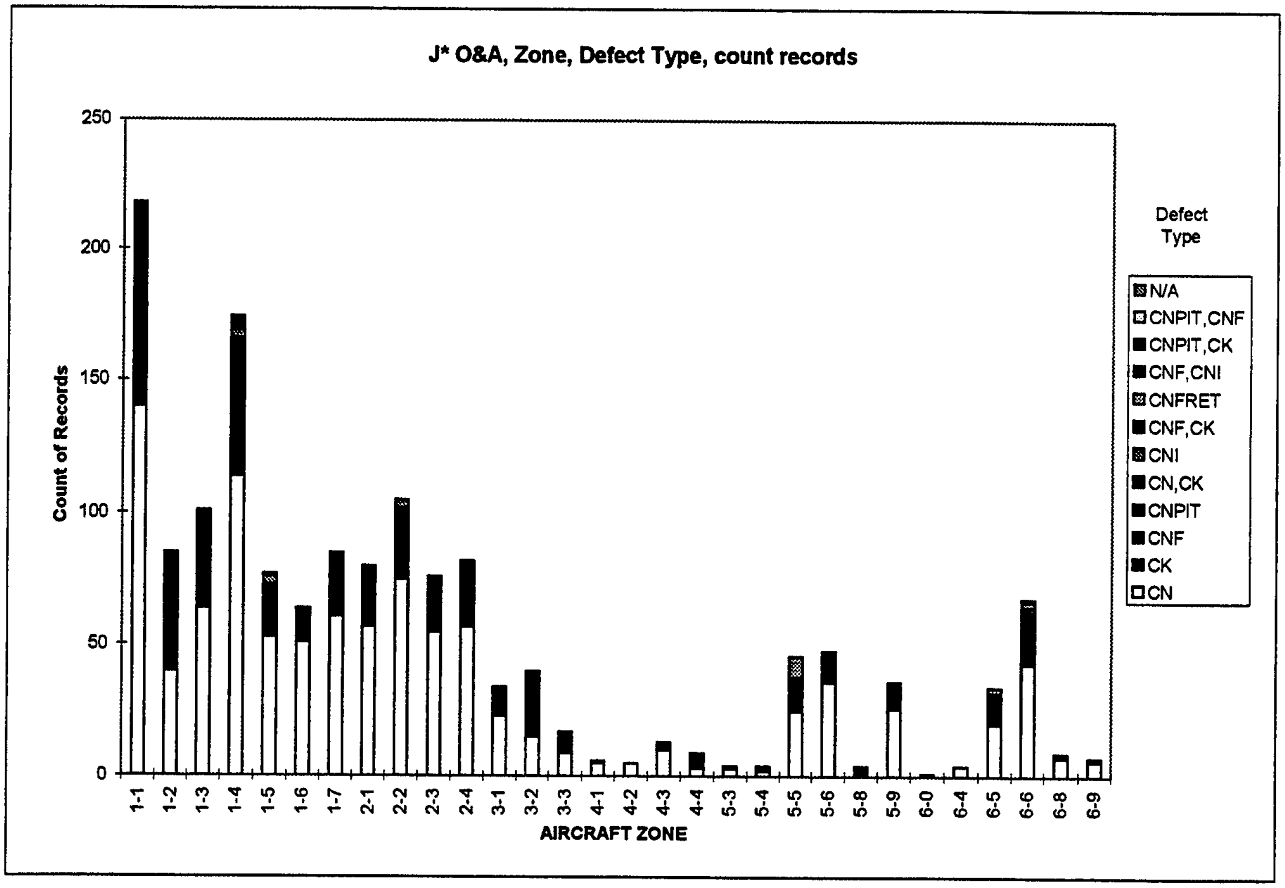


Figure 3.28 Northrop-Grumman E-8C JSTARS O&A, Count Records Grouped by Aircraft Work Zone Location Cross-Tabbed by Defect Type.

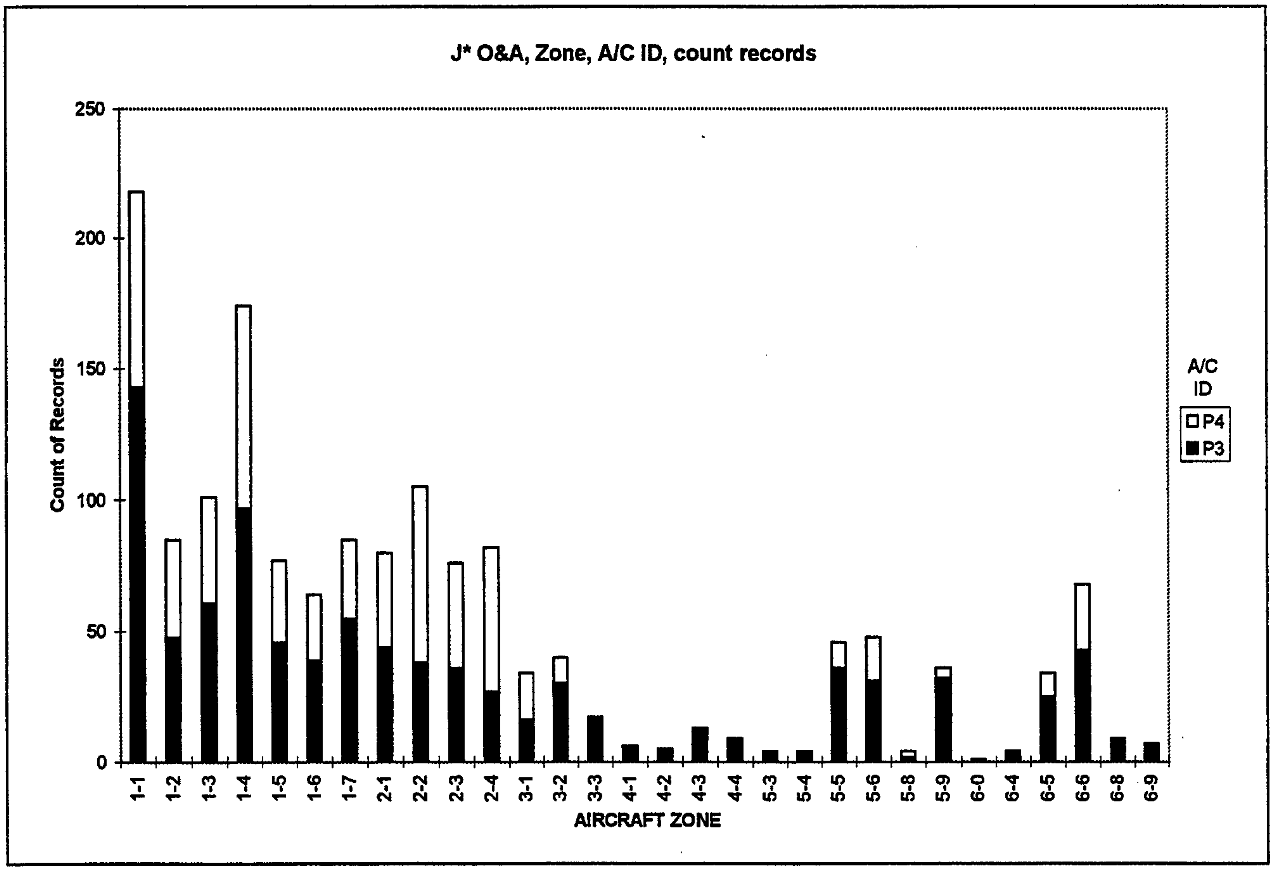


Figure 3.29 Northrop-Grumman E-8C JSTARS O&A, Count Records Grouped by Aircraft Work Zone Location Cross-Tabbed by Aircraft ID.

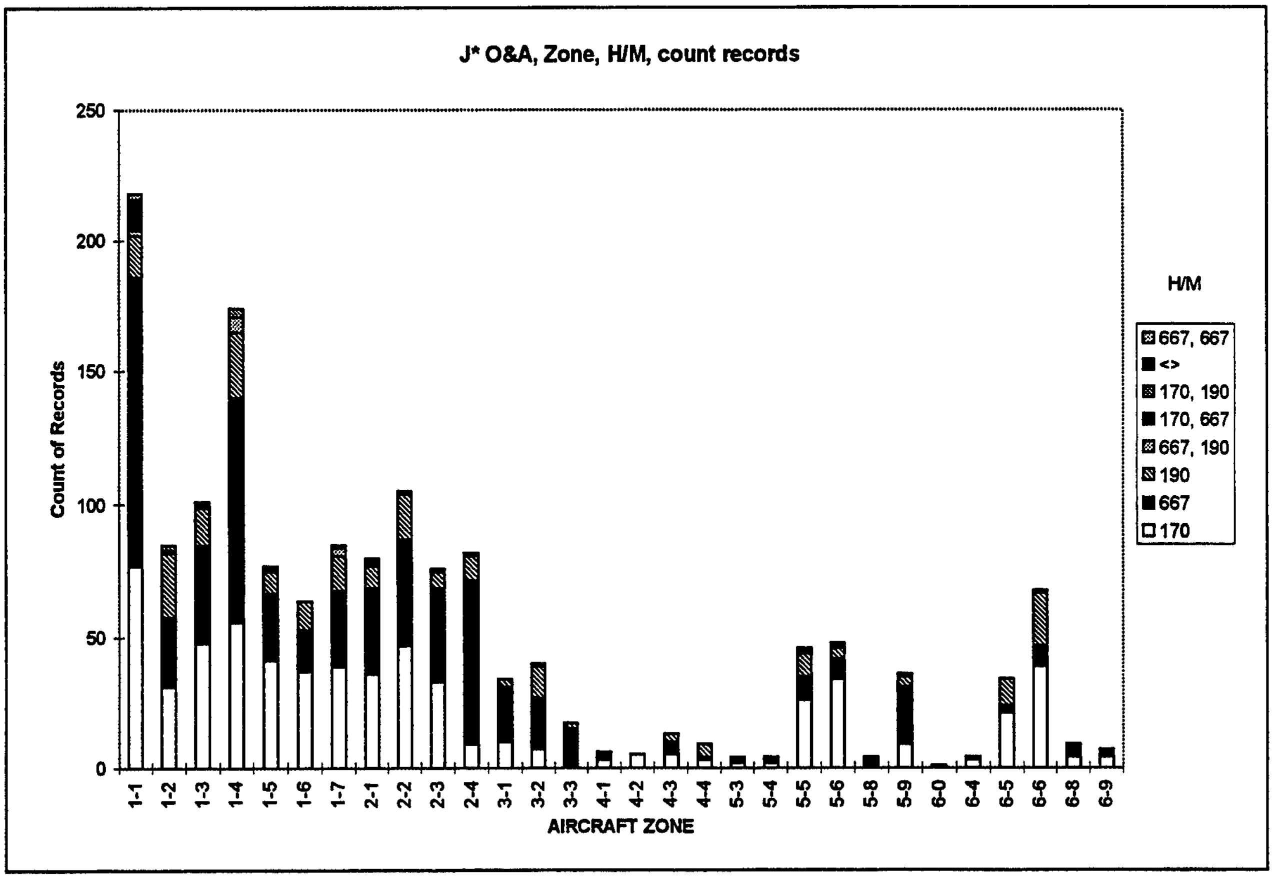


Figure 3.30 Northrop-Grumman E-8C JSTARS O&A, Count Records Grouped by Aircraft Work Zone Location Cross-Tabbed by How Malfunction (H/M) Code (Note that 667 = Severe Corrosion, 170 = Mild/Moderate Corrosion, and 190 = Cracked).

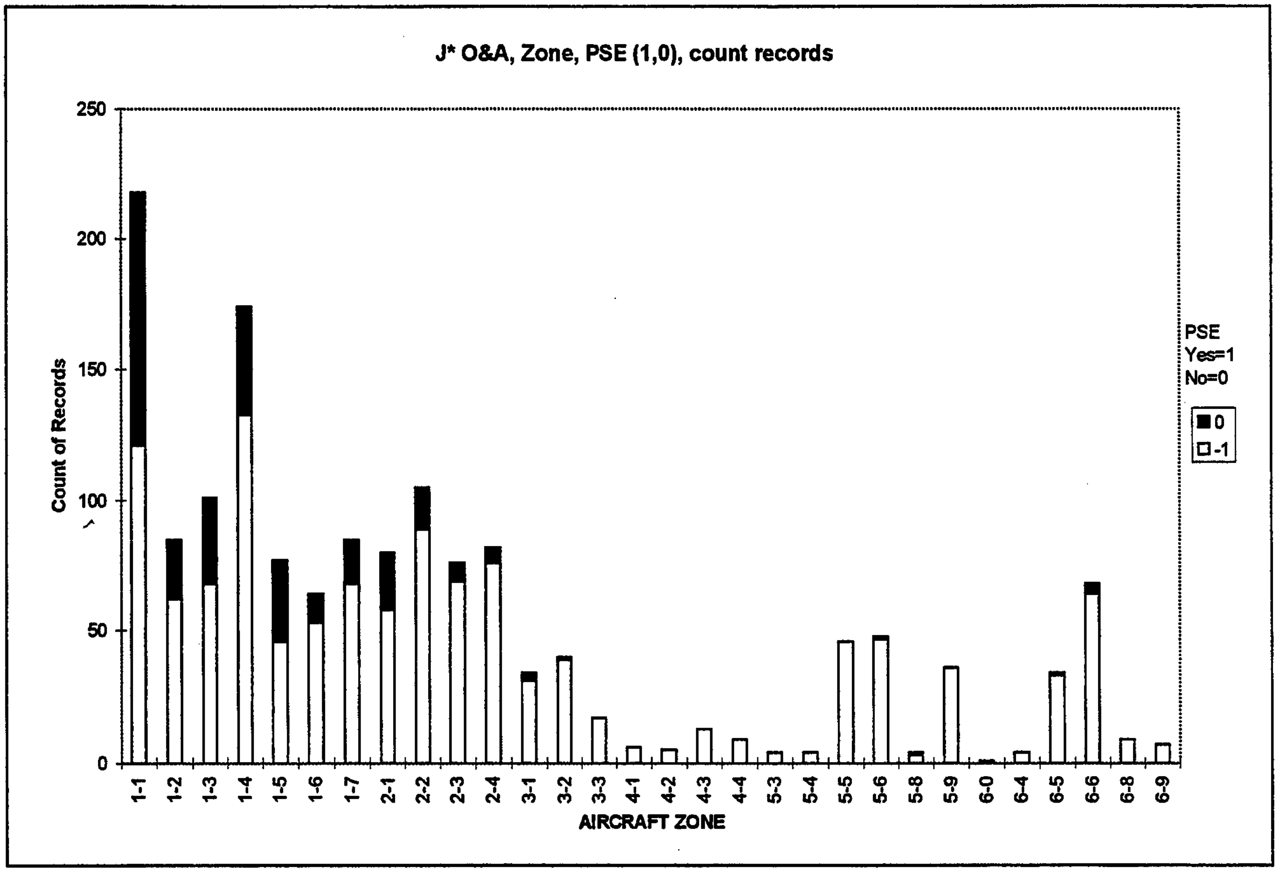


Figure 3.31 Northrop-Grumman E-8C JSTARS O&A, Count Records Grouped by Aircraft Work Zone Location Cross-Tabbed by Principal Structural Element (PSE) Classification (yes/no).

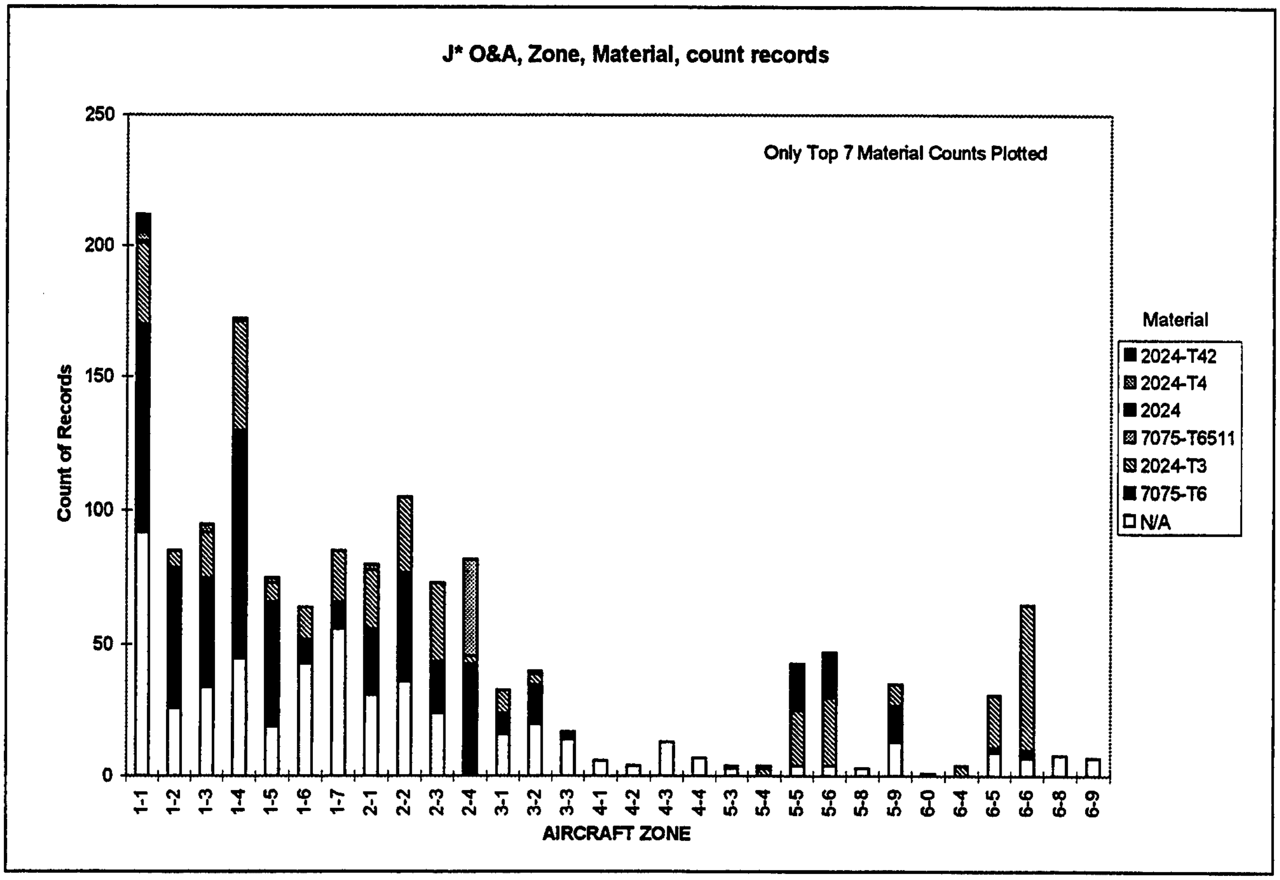


Figure 3.32 Northrop-Grumman E-8C JSTARS O&A, Count Records Grouped by Aircraft Work Zone Location Cross-Tabbed by Material Type of the Structural Element.

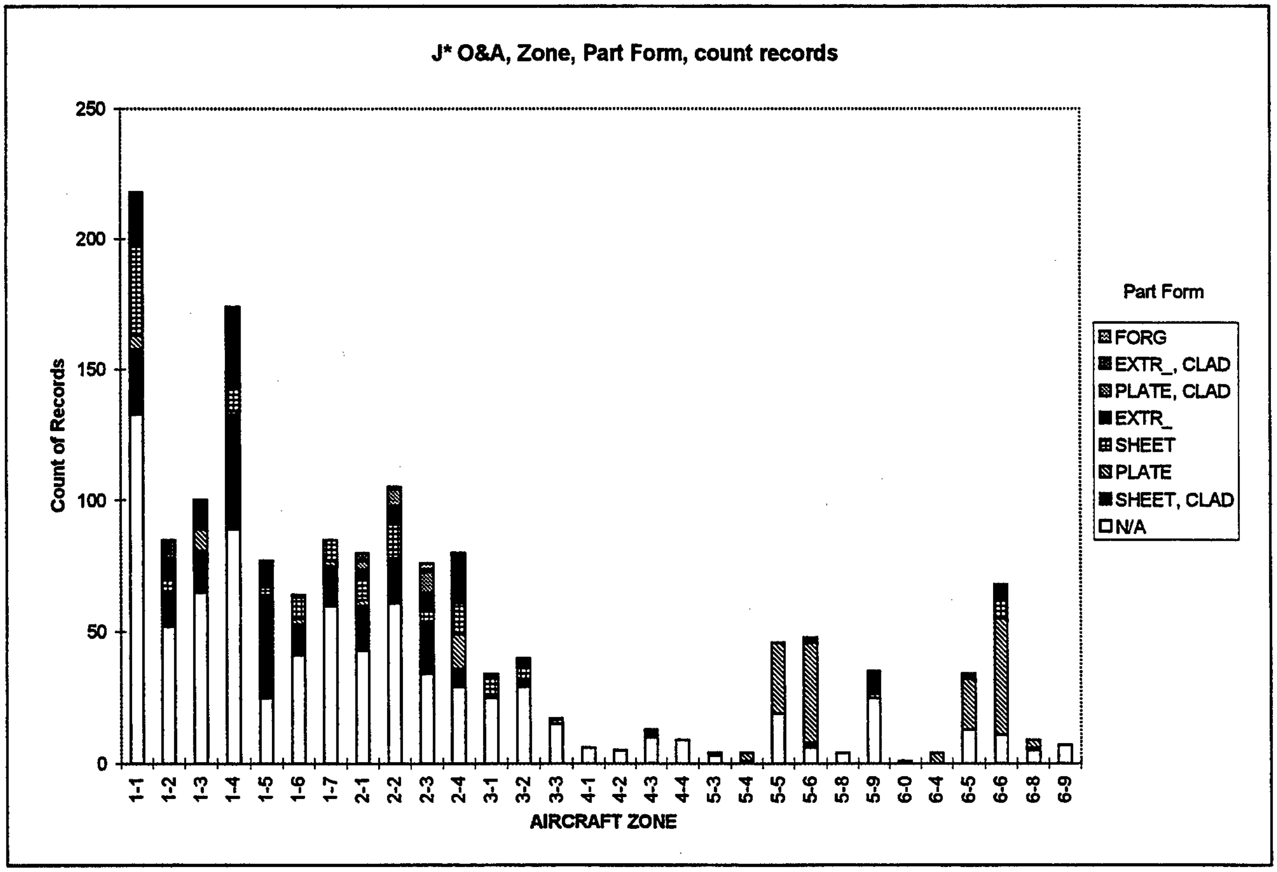


Figure 3.33 Northrop-Grumman E-8C JSTARS O&A, Count Records Grouped by Aircraft Work Zone Location Cross-Tabbed by Part Form of the Structural Element.

Table 3.16 Northrop-Grumman E-8C JSTARS O&A, Count Records Grouped by Aircraft Work Zone Location and Major Station Frame Join Locations on the Body (BS) and Wing (WS) Cross-Tabbed by Defect Code (as defined by Northrop-Grumman).

J* O&A, Zone, Defect, Station, count records

Sum = 239 44 34 7 6 5 4 339 339

Defect
Count of Records

Location	AIRCRAFT ZONE	CN	CNF	CK	CNPIT	CNI	CNF,CK	CN,CK	sum	SUM
BS 304	1-1	2							2	
	1-4	1							1	
	2-1	1							1	4
BS 360	1-1	25	8	1	2		1		37	
	1-2	10	2	1					13	
	1-4	3							3	
	2-1	1							1	
	2-2	1							1	
	2-4	6							6	61
BS 600	1-2	13	4	14		2	1		34	
	1-3	17	5						22	
	1-5	2				1			3	
	2-1	1							1	
	2-2	19	2	3					24	
	2-3	2							2	
	2-4	7	4	2		1			14	100
BS 820	1-3	11	7	1			1		20	
	1-6	12							12	
	1-7	12	1						13	
	2-2	2							2	
	2-3	5							5	
	2-4	2	1						3	55
BS 960	1-3	1							1	
	1-4	15	2	2	1	1	2	1	24	
	1-6	6		4					10	
	1-7	13	3	1		1		3	21	
	2-3	10		1					11	
	2-4	2	1	1					4	
	5-9	4			2				6	77
BS 1440	1-4	6							6	
	1-5	7		1	1				9	
	2-3	7	4						11	
	2-4	2							2	28
WS 360	5-5	4							4	
	5-6	1		1	1				3	
	5-9	1							1	
	6-0	1							1	
	6-5	2							2	11
WS 733	5-4			1					1	
	6-0	1							1	
	6-5	1							1	3

Table 3.17 Northrop-Grumman E-8C JSTARS O&A, Count Records Grouped by Structural Element Key Word in the Nomenclature Description Cross-Tabbed by Defect Type Code (as defined by Northrop-Grumman).

J* O&A, Defect, Nomen like ?, count records

Sum	892	169	138	44	18	13	10	1	1285

Defect Type
Count of Records

Nomenclature w/	CN	CK	CNF	CNPIT	CN,CK	CNI	CNF,CK	CNPIT,CNF	Sum
Skin or Panel	203	12	17	25	3	0	0	0	260
Frame	116	30	32	6	1	0	1	0	186
Angle	104	25	21	1	2	1	0	0	154
Stringer	85	18	22	2	2	6	1	0	136
Web	99	25	7	2	2	1	0	0	136
Beam	95	8	23	1	2	2	1	0	132
Plank	97	22	3	4	2	2	1	1	132
Intercostal	32	19	5	2	3	1	5	0	67
Bulk	42	7	6	1	1	0	0	0	57
Rib	19	3	2	0	0	0	1	0	25

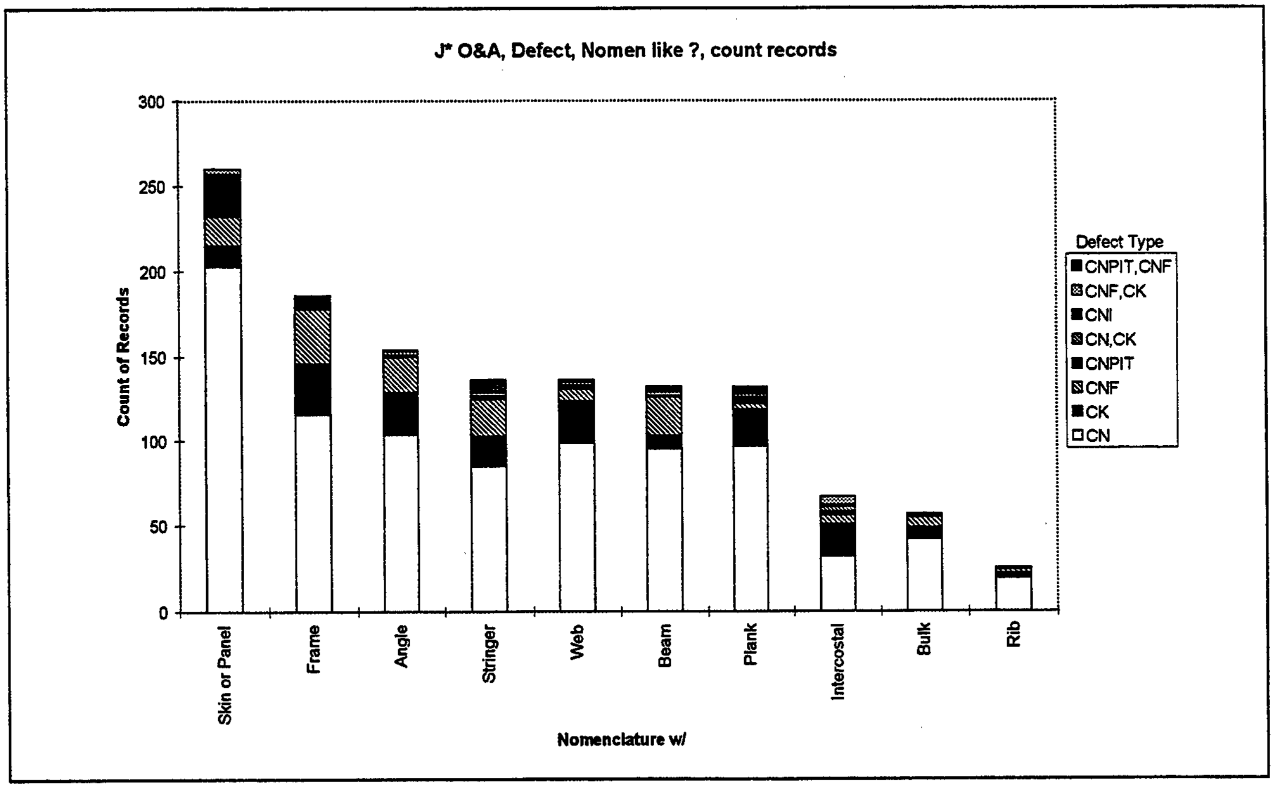


Figure 3.34 Northrop-Grumman E-8C JSTARS O&A, Count Records Grouped by Structural Element Key Word in the Nomenclature Description Cross-Tabbed by Defect Type Code (as defined by Northrop-Grumman).

Table 3.18 Northrop-Grumman E-8C JSTARS O&A, Count Records Grouped by Structural Element Key Word in the Nomenclature Description and Aircraft Work Zone Cross-Tabbed by Defect Type Code (as defined by Northrop-Grumman)

J* O&A, Zone, Defect, Nomen like ?, count records

Defect Type
Count of Records

Nomenclature w/	AIRCRAFT ZONE	CN	CK	CNF	CNPIT	CN CK	CNI	CNF CK	CNPIT CNF	Sum
Plank	5-4	2				1				3
	5-5	13	4	3				1		21
	5-6	25	1		2	1			1	30
	5-9	2	1							3
	6-4	3								3
	6-5	18	5				1			24
	6-6	32	11		2		1			46
	6-8	2								2
Skin or Panel	1-1	17			5					22
	1-2	4	1	3	1					9
	1-3	11	3	4	1					19
	1-4	35	1		6					42
	1-5	26	1	1	6	1				35
	1-6	3								3
	1-7	6								6
	2-1	18	4	2	2	1				27
	2-2	34	2	1	1					38
	2-3	26		1	3	1				31
	3-1	9								9
	3-2	2		3						5
	3-3	2		1						3
	4-2	2								2
	4-3	1								1
	5-3	1								1
	5-6			1						1
	5-9	2								2
	6-6	2								2
	6-9	2								2

3.3 C-9A/C Nightingale

One database was used to estimate the extent of corrosion and cracking for the C-9A/C fleet of aircraft. The OACIS database was queried to generate information covering the entire fleet. The following discusses the database queries and the results they indicate. The results are estimates of which principal structural elements (PSEs) are being found with corrosion and fatigue cracking damage.

3.3.1 C-9A/C Nightingale - OACIS

Table 3.19 lists all the queries in the C-9A/C OACIS database (C9OACIS.mdb). Note that the query title in the database appears on each figure or table displaying the query results. The first group of OACIS queries is intended to identify general trends in the data concerning corrosion and cracking. First, the OACIS database was queried to separate the corrosion and cracking damage records from others contained in the database by counting records grouped by the How Malfunction Code (H/M). The results from this query are presented in Table 3.20. Note that of the 12950 total records in the OACIS database, corrosion and cracking account for 11763 records (~91%). In OACIS, corrosion is recorded as severe (H/M=667) or mild (H/M=170) while the cracking code (H/M=190) has no associated degree of damage. Of the 11763 records, the largest group is mild corrosion at 95% and the smallest group is cracking at 1%.

Next, a query was performed that counted records grouped by tail number where the H/M codes are corrosion (667 or 170) or cracking (190). The query results are presented in Figure 3.35. Note that two tail number formats have been entered into the tail number field. This kind of data entry inconsistency could misrepresent the trends and conclusions developed. Also note that in each of the two formats, 30 tail numbers are present. The information needed to try to combine this data was not collected under this effort. This trend could identify the tail numbers that experience the most repairs for corrosion or cracking. This could be useful in other efforts to identify unique characteristics of these aircraft that may drive higher then average corrosion occurrences (i.e. usage, location, and cargo type). Also note that the USAF Fact sheets in Appendix A lists only 9 operational aircraft while the 1997 AMMP in Appendix B lists

18 active aircraft. These differences involving the tail numbers counted were not resolved under this effort.

Next, several queries were performed that counted records grouped by work area (W/A), work zone (W/Z), and work unit code (WUC) where the How-Malfunction code is 667, 170, or 190. The W/A code identifies a specific location on the airframe where inspections and repair work is performed. The W/Z code identifies a smaller location within a work area. The WUC is a specific work instruction involving a specific set of structural elements and work procedures. The work area and zone code definitions for the C-9A/C are defined in Table 2.12 while work unit code definitions were not gathered under this effort. Work area and zone codes denote a location and work unit code denotes selected structural elements (and therefore also a location). Figures 3.36 and 3.37 present the Pareto trends for work area code and work unit code respectively. The WUCs with the top three record count values are 11210, 11219, and 11211. With 1272 unique WUCs records in the OACIS database, these top three WUCs account for only 12% of the 11763 records with corrosion and cracking damage. The W/A codes with the top three record count values are 05, 01, and 06, which are identified from Table 2.12 as pressurized fuselage, wings, and aft un-pressurized fuselage respectively. These three W/A codes account for 74% of the 11763 records in OACIS found with corrosion and cracking damage.

In order to develop more detailed information, several queries were performed that cross-tabbed W/Zs with selected W/As, W/As & W/Zs with WUC, and W/As with year. Figure 3.38 presents query results that counted records grouped by work zone for the top two work area codes (05 = wing and 01 = pressurized fuselage). The results identify the top two work zones on the wing as the left and right trailing edge structure aft of the rear spar while the top work zone on the pressurized fuselage is the cabin & lavatory area. Table 3.21 presents a query that counted records grouped by W/Z codes where the W/A codes are 01 and 05 and the WUC is 11210. For the number of records in the OACIS database, these results, totaling only 645 records, are negligible. Figure 3.39 presents the query that counted records grouped by year the repair was completed crossed-tabbed by work area code. Note the decline in record counts in 1994 and 1995.

This query could be correlated with the number of aircraft that were repaired in each year to check the average number of repairs per year and per aircraft.

The next group of OACIS queries is intended to identify specific PSEs with higher occurrences of corrosion and cracking records. Several queries were performed that counted corrosion and cracked records grouped by a selected PSE key word that was found in the discrepancy text field. The initial list of PSE key words is identified in Figure 3.1. Several queries and manual reviews of individual records were performed to select the final list of key words. The Pareto trend developed from these queries is shown in Table 3.22. The six PSE key words listed account for about 40% of the 11763 corrosion and cracking records with "skin" accounting for the large majority. The records identified for the PSE key word "skin" also include "panel" and "plank".

The location of the damaged PSEs identified in Table 3.22 can also be determined by a cross-tab query on work area and work zone. Table 3.23 identifies the work areas where the corroded or cracked "skin" PSEs were found. The work area codes with the top two record count values are 01 (wings) and 05 (pressurized fuselage). Note that these are the same W/As as those identified in Figure 3.36 but with the ranking switched. Next the work zones for the "skin" PSEs in the 01 and 05 work areas are listed in Table 3.24. For the wings, the largest group of "skin" PSEs found with damage occur in the 05 and 06 work zones defines as the left and right trailing edge structure aft of the rear spar. For the pressurized fuselage, the largest group of "skin" PSEs found with damage occur in the 08 work zone defined as the cabin and lavatory. Note that these work zones are the same as those identified in Figure 3.38.

In general, cracking is not a high driver of repairs for the C-9A/C fleet. Mild corrosion accounts for the large majority repairs. From the above summary of repair records there is still a large amount of data not represented in the above list of PSE key words. To better identify the ranking of PSEs with corrosion, a series of queries could be performed searching for records with a broader selection of PSE key words to identify more complete set corrosion record counts for each PSE group. For those PSEs identified, "skin" structural elements account for the majority of records counted. The locations of the majority of these "skin" PSEs are the wings and pressurized fuselage.

Table 3.19 List of Queries in the C-9 OACIS Access Database (C9OACIS.mdb)

Name of Queries in C9OACIS.mdb
C9 OACIS, How Mal, count records
C9 OACIS, Tail #, 667&170&190, Count Records
C9 OACIS, Tail #, 667&170&190, Ct Rec. w/ Descrep *beam*
C9 OACIS, Tail #, 667&170&190, Ct Rec. w/ Descrep *bulk
C9 OACIS, Tail #, 667&170&190, Ct Rec. w/ Descrep *frame*
C9 OACIS, Tail #, 667&170&190, Ct Rec. w/ Descrep *skin
C9 OACIS, Tail #, 667&170&190, Ct Rec. w/ Descrep *stringer*
C9 OACIS, Tail #, 667&170&190, Descrep w/ *beam*
C9 OACIS, Tail #, 667&170&190, Descrep w/ *bulk*
C9 OACIS, Tail #, 667&170&190, Descrep w/ *frame
C9 OACIS, Tail #, 667&170&190, Descrep w/ *skin*
C9 OACIS, Tail #, 667&170&190, Descrep w/ *stringer*
C9 OACIS, Tail #, Year, 667&170&190, Count Records
C9 OACIS, Work Area 05&01, 667&170&190, Ct Rec. w/ Descrep *skin*
C9 OACIS, Work Area 05&01, 667&170&190, Tail #, Descrep w/ *skin*
C9 OACIS, Work Area 05&01, Zone, 667&170&190, Count Records
C9 OACIS, Work Area, 667&170&190, Count Records
C9 OACIS, Work Area, 667&170&190, Ct Rec. w/ Descrep *?*
C9 OACIS, Work Area, 667&170&190, Ct Rec. w/ Descrep *beam*
C9 OACIS, Work Area, 667&170&190, Ct Rec. w/ Descrep *bulk*
C9 OACIS, Work Area, 667&170&190, Ct Rec. w/ Descrep *floor*
C9 OACIS, Work Area, 667&170&190, Ct Rec. w/ Descrep *frame
C9 OACIS, Work Area, 667&170&190, Ct Rec. w/ Descrep *skin*
C9 OACIS, Work Area, 667&170&190, Ct Rec. w/ Descrep *stringer*
C9 OACIS, Work Area, Year, 667&170&190, Count Records
C9 OACIS, Work Area, Zone, WUC 11210, 667&170&190, Count Records
C9 OACIS, WUC, 667&170&190, Count Records

Table 3.20 C-9 OACIS, Count Records Grouped by How Malfunction Code (How Mal).

C9 OACIS, How Mal, count records

Sum 12950

How Mal Code	Description	CountOfRecord
170	Corroded Mild/Moderate	11171
667	Corroded Severe	452
105	Loose, damaged, or missing hardware	140
190	Cracked	140
20	Worn, Chaffed, frayed, or torn	115
0		99
246		78
70	Broken	74
846	Delaminated	66
553	Does not meet specifications	55
117		49
780		36
800		32
799		27
710	Bearing failure	24
804		22
935		21
865	Deteriorated	21
750		19
127		17
135		16
425		16
212		16
301		14
520		12
381		11
295		10
120		10
17		9
429		7
110		7
167		7
211		6
6		6
5		5
730		4
178		4
242		4
76 other codes with counts < 4		128

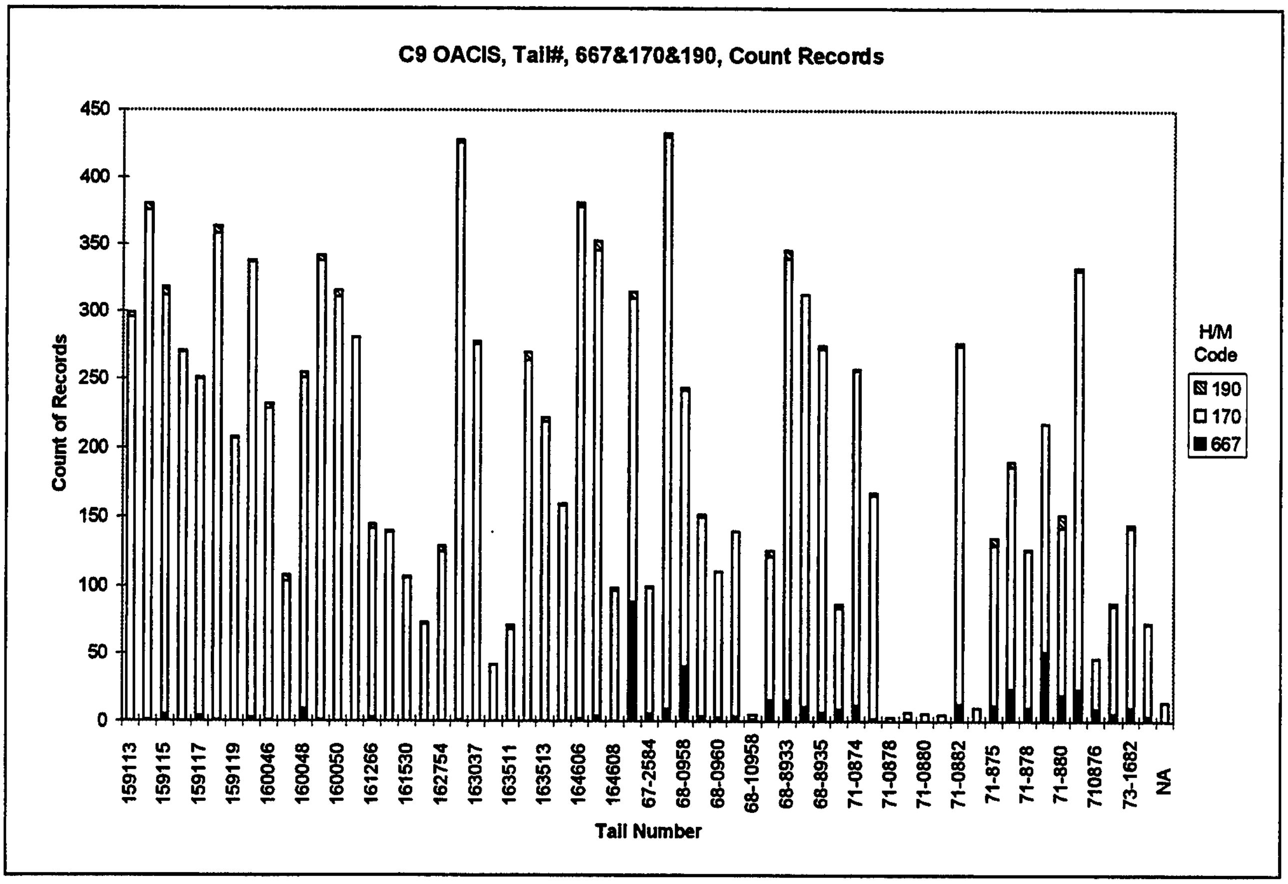


Figure 3.35 C-9 OACIS, Count Records Grouped by Aircraft Tail Number where the How Malfunction (H/M) Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), and 190 (Cracked).

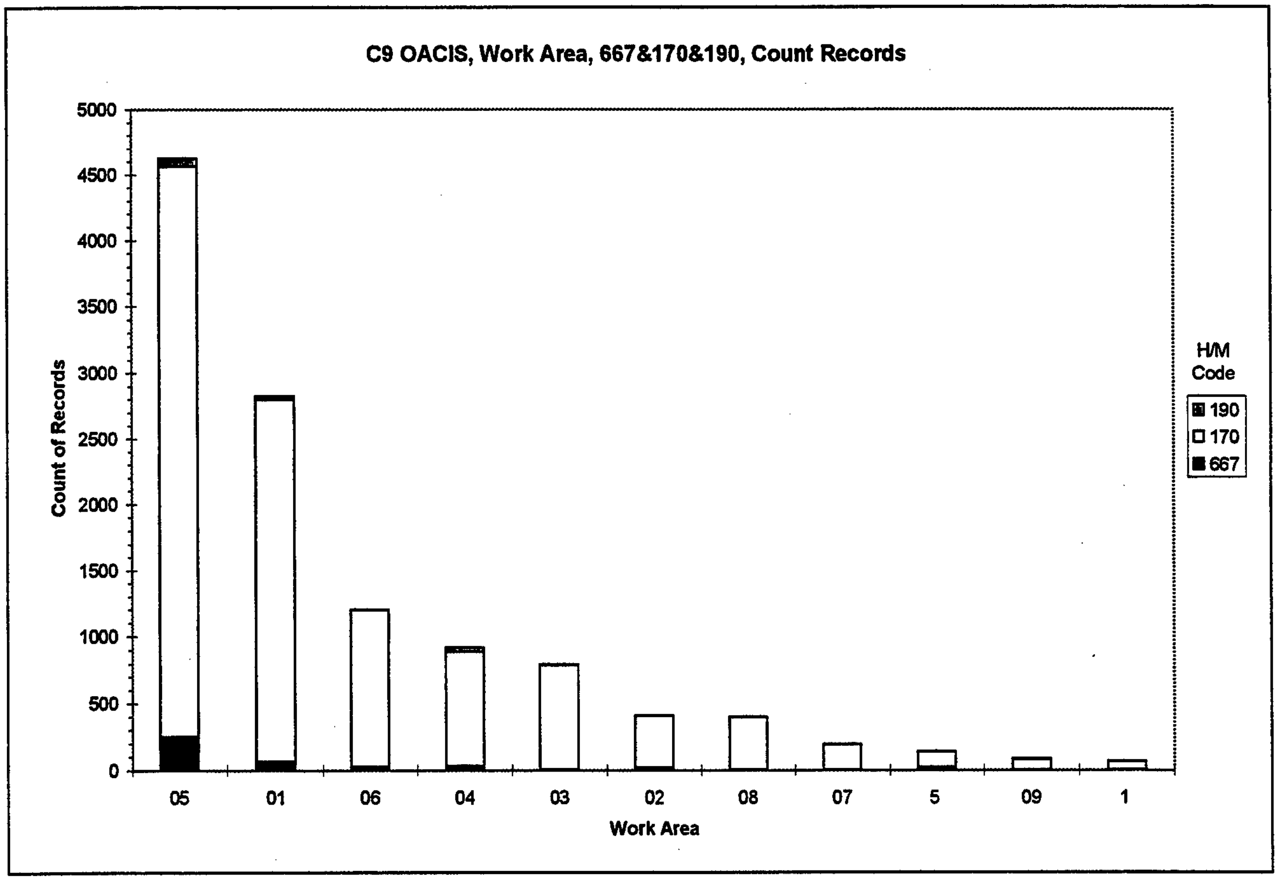


Figure 3.36 C-9 OACIS, Count Records Grouped by Work Area where the How Malfunction (H/M) Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), and 190 (Cracked).

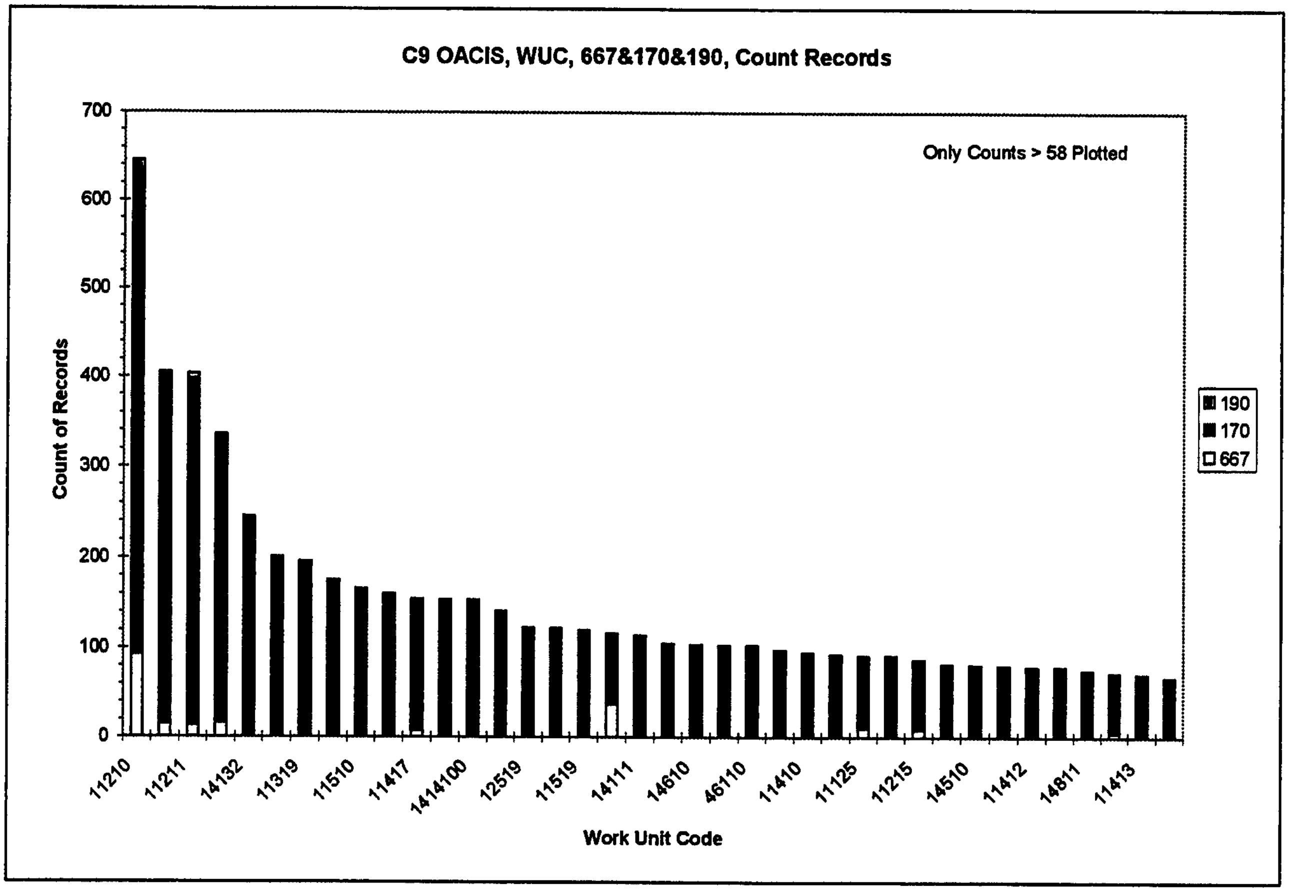


Figure 3.37 C-9 OACIS, Count Records Grouped by Work Unit Code (WUC) where the How Malfunction (H/M) Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), and 190 (Cracked).

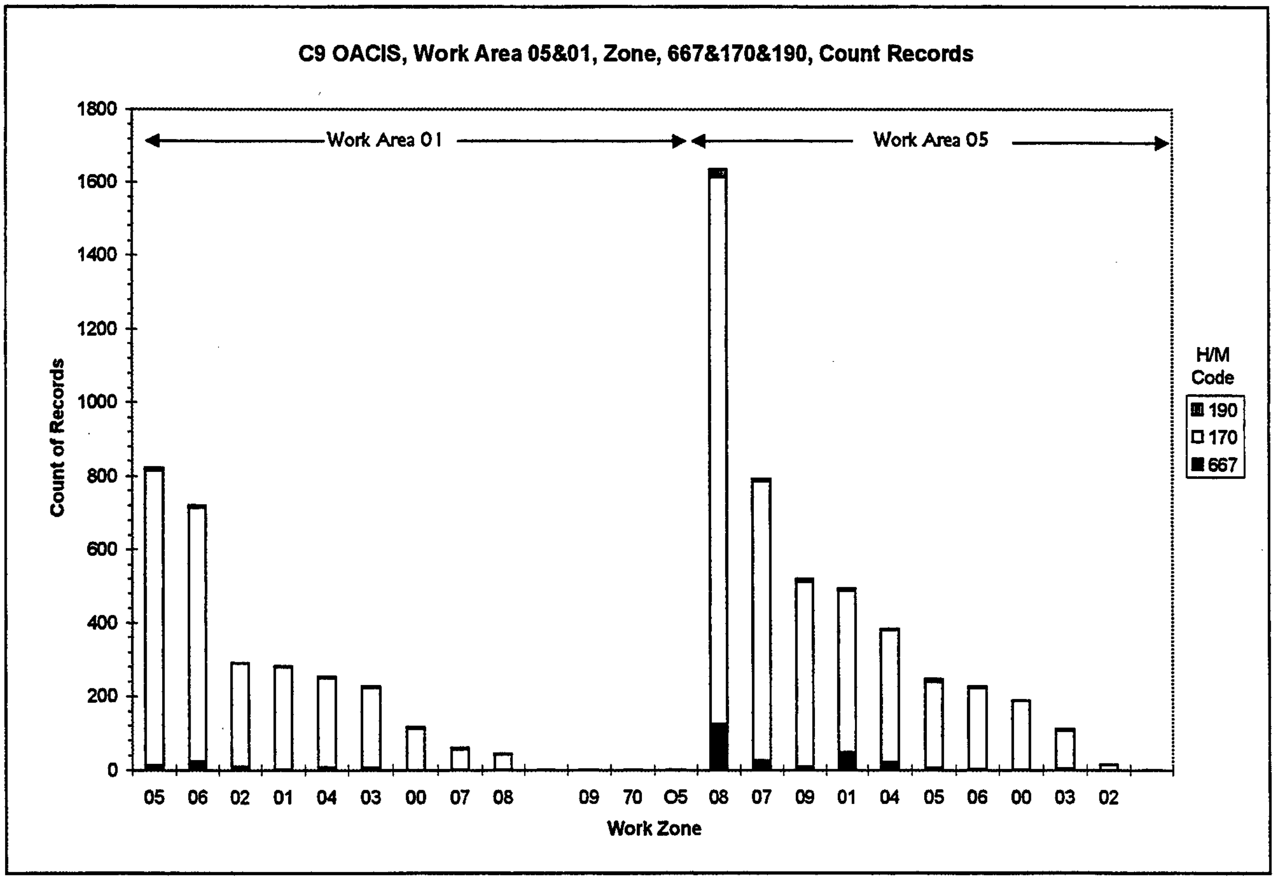


Figure 3.38 C-9 OACIS, Count Records Grouped by Work Zone where the Worked Area is 01 & 05 and where the How Malfunction (H/M) Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), and 190 (Cracked).

Table 3.21 C-9 OACIS, Count Records Grouped by Work Area and Work Zone where the Work Unit Code (WUC) = 11210 and where the How Malfunction (H/M) Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), and 190 (Cracked).

C9 OACIS, Work Area, Zone, WUC 11210, 667&170&190, Count Records

	Sum	93	543	9	645

Work Area	Work Zone	667	170	190	Sum
05	08	24	128	3	155
05	07	8	100	1	109
05	01	24	56	1	81
05	04	16	60		76
02	03	6	31	1	38
05	09		30		30
06	01		20		20
05	05	2	13	2	17
05	03	4	12		16
02	01		15		15
05	06	4	9		13
05	00		12		12
04	06		11		11
5	1		10		10
02	02		7		7
5	3	3	3		6
5	8		6		6
5	4		4	1	5
5	7	1	3		4
02	00		2		2
5	0		2		2
5	5		2		2
			1		1
01	06		1		1
03	05		1		1
04	04	1			1
04	05		1		1
05			1		1
05	02		1		1
Z	17		1		1

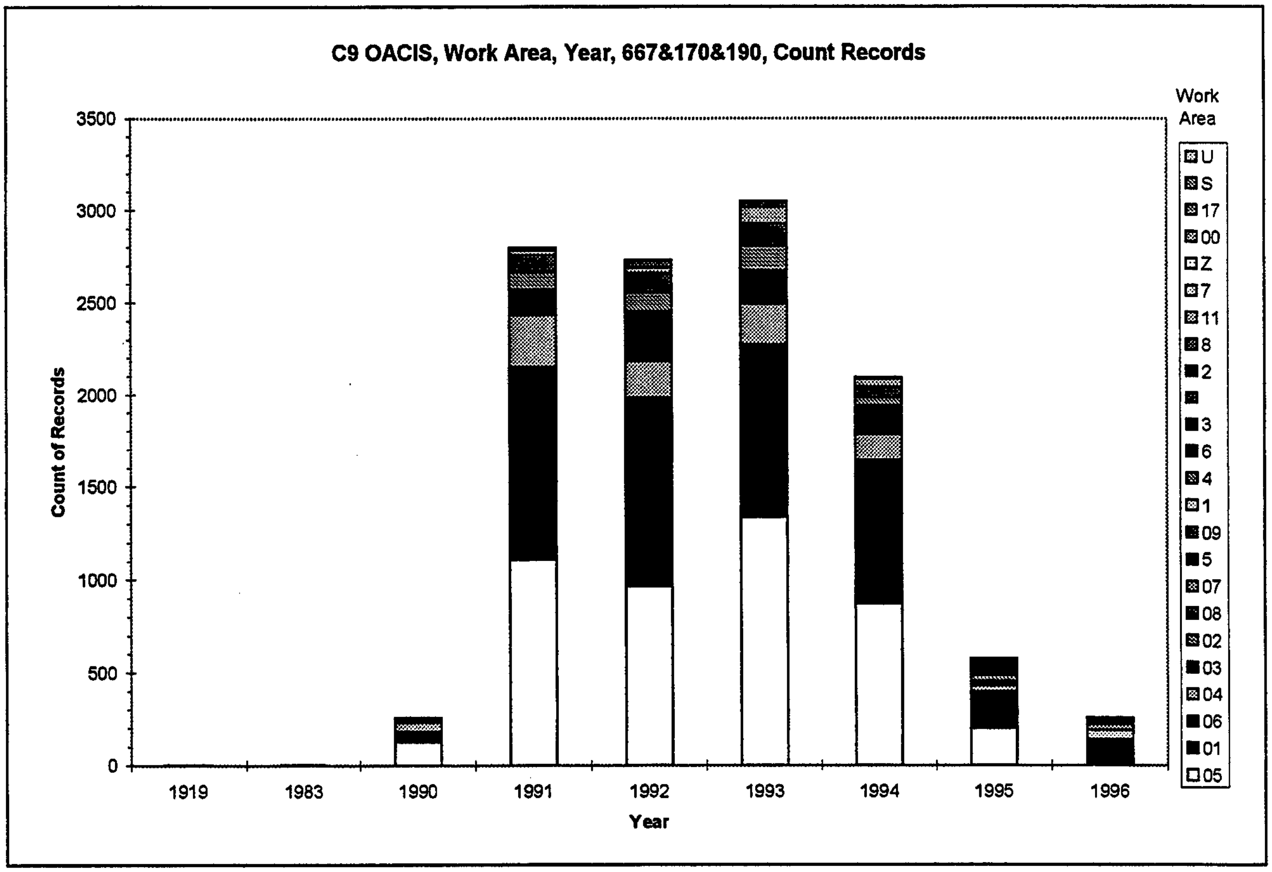


Figure 3.39 C-9 OACIS, Count Records Grouped by Year the Repair Order was Completed Cross-Tabbed by Work Area and where the How Malfunction (H/M) Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), and 190 (Cracked).

Table 3.22 C-9 OACIS, Count Records Grouped by PSE Key Words in the Discrepancy Field where the How Malfunction (H/M) Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), and 190 (Cracked).

C9 OACIS, Work Area, 667&170&190, Ct Rec w/ Descrep *?*

Sum	161	4303	52	4516

H/M Code
Count of Records

Discrepency w/	667	170	190	Sum
skin	56	2857	30	2943
floor	58	740	15	813
frame	19	384	4	407
beam	22	283	2	307
bulk	4	27	1	32
stringer	2	12		14

Table 3.23 C-9 OACIS, Count Records Grouped by Work Area where the PSE Key Word in the Discrepancy Field is "skin" and the How Malfunction (H/M) Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), and 190 (Cracked).

C9 OACIS, Work Area, 667&170&190, Ct Rec w/ Descrep *skin*

Sum	56	2857	30	2943

H/M Code
Count of Records

Work Area	667	170	190	Sum
01	11	997	9	1017
02	2	147		149
03		246	1	247
04	9	188	3	200
05	16	809	9	834
06	2	222	3	227
07		26		26
08	3	142	2	147
09	2	26	1	29
1	3	20	1	24
11		3		3
2		2		2
3		3		3
4	1	4	1	6
5	6	18		24
6	1	2		3
8		2		2
Z		1		1

Table 3.24 C-9 OACIS, Count Records Grouped by Work Area = 01 & 05 and Work Zone where the PSE Key Word in the Discrepancy Field is "skin" and the How Malfunction (H/M) Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), and 190 (Cracked).

C9 OACIS, Work Area 05&01, 667&170&190, Ct Rec w/ Descrep *skin*

		H/M Code Count of Records			
	Sum	27	1806	18	1851
Work Area	Work Zone	667	170	190	Sum
05	08	7	294	6	307
01	05	1	254	2	257
01	06	7	235	2	244
01	01		132	1	133
05	07		122		122
01	02		102	1	103
01	04	2	95		97
01	00		87	1	88
01	03	1	86	1	88
05	00	2	78		80
05	04	1	76		77
05	01	5	63	1	69
05	05		47	1	48
05	03	1	42	1	44
05	06		44		44
05	09		41		41
01	07		3		3
01	08		2	1	3
01	O5		1		1
05			1		1
05	02		1		1

3.4 C-130 Hercules

Four databases containing repair records (documenting damage caused by corrosion or fatigue) were used to estimate the extent of corrosion and cracking for the C-130 fleet of aircraft. Each database includes records for a large number of aircraft such that the entire fleet of aircraft is likely represented. The ARINC database containing C-130 structural integrity information is also available to provide details of DADTA points for the C-130E/H airframes. The results from queries of these five databases are estimates of which principal structural elements (PSEs) and DADTA structure are being found with corrosion and fatigue cracking damage.

AFMC202 and OACIS primarily include information from records of repairs performed at the PDM facility that required an engineering disposition. Recall that OACIS archives information on only those engineered repairs that were over and above the level of repair authorized in the PDM contract. The PDM facility for the C-130 fleet is WR-ALC. The AIRS database includes information from both depot and field level inspection and repair records recorded on AFTO Form 58, which is explained in detail in Reference [20]. The REMIS database primarily includes the occurrences of field level repairs for corrosion.

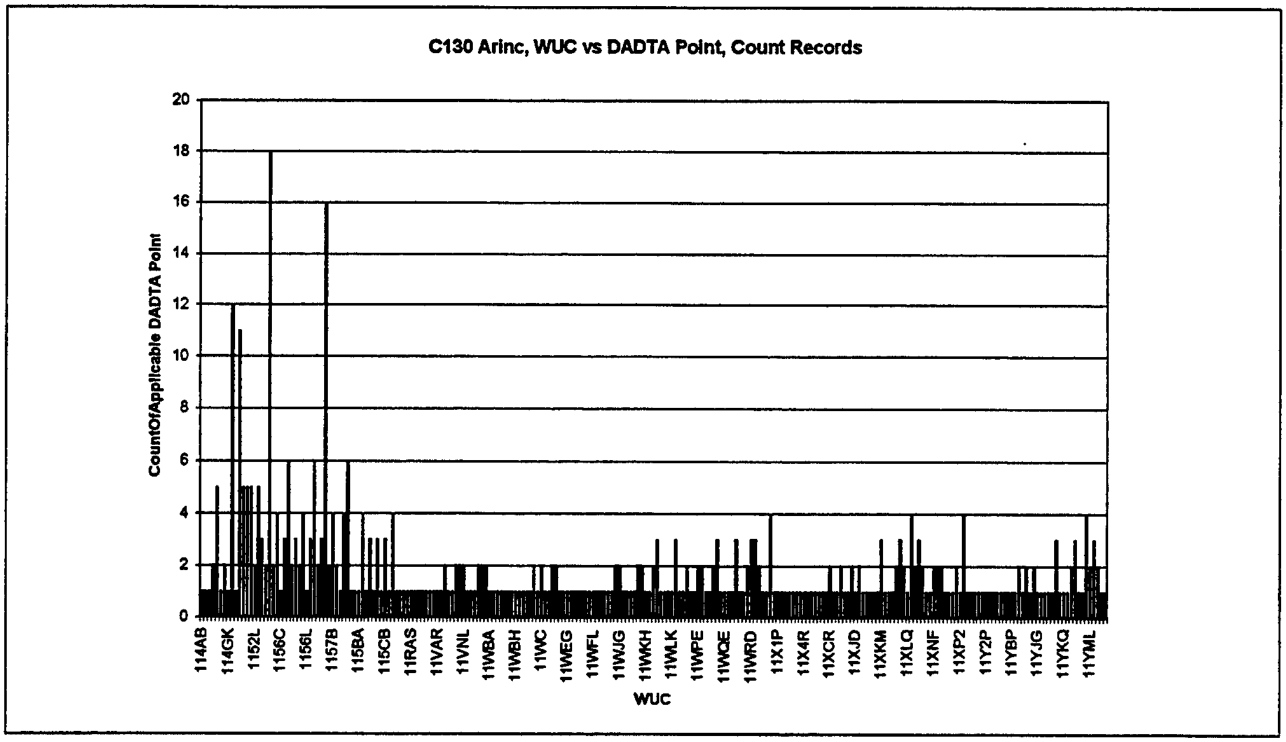
The ARINC database includes five data tables, which provide information and descriptions of the C-130 model design series (MDS), NDI methods, work unit code (WUC) descriptions, critical component data, and a listing of WUC's versus DADTA points. Table 2.11 provides a listing of the C-130 ARINC data tables and their content. The critical component data table identifies the DADTA points and some of the associated analysis and force management information. Work unit codes are pre-prepared work instructions for selected components used as part of repair/maintenance actions. The table of WUC's Vs DADTA points lists the DADTA points associated with each applicable WUC. Thus, linking the table of WUC versus DADTA points to a repair database with a WUC field can extract or separate the repairs on DADTA points. Queries of the four repair record databases identified above include several where the ARINC data tables were linked to assist in identifying damage found and repaired on DADTA points.

In order to establish a preferred method for linking the four databases containing repair records with the ARINC database many trial queries and linking methods were performed followed by manual checking of the resulting data trends. It became apparent that the ARINC data table of Critical Component Data was entered in a format that, for some WUC's, yielded incorrect (high) record counts. This is due to the repeating of DADTA points common to each C-130 model design series (i.e. C-130E and C-130H). In addition, the data table of DADTA points versus WUC's includes, for some cases, multiple DADTA points for one WUC and multiple WUC's for one DADTA point.

In order to illustrate this problem, two queries were performed of the WUC versus DADTA Point table. Figure 3.40a shows the count of DADTA points for each WUC listed in the table. Note that there are 243 unique WUC's with 62% having just one DADTA point. Figure 3.40b shows the count of WUC's for each DADTA point listed in the table. Note that there are 74 unique DADTA points with all having at least two WUC's. As an example of the problem this creates, Table 3.25 shows C-130 OACIS record counts grouped by WUC for Tail number 55-0022. Listed are 21 unique WUC,s, three of which have associated DADTA points. Since the records do not indicate which DADTA points were repaired then all DADTA points would be counted for each record. For this one aircraft, which has 33 total records listed, 72 records would be counted when limiting to DADTA points. The end result is that most record counts will be inflated when the query has linked the WUC in the repair record to the table of DADTA points.

Still, the ARINC data tables are quite useful in augmenting the repair databases. The relative order of magnitude of the damage on DADTA points versus all structural elements is estimated and it does identify which DADTA points are being repaired (even thought the counts may be inflated).

a.



b.

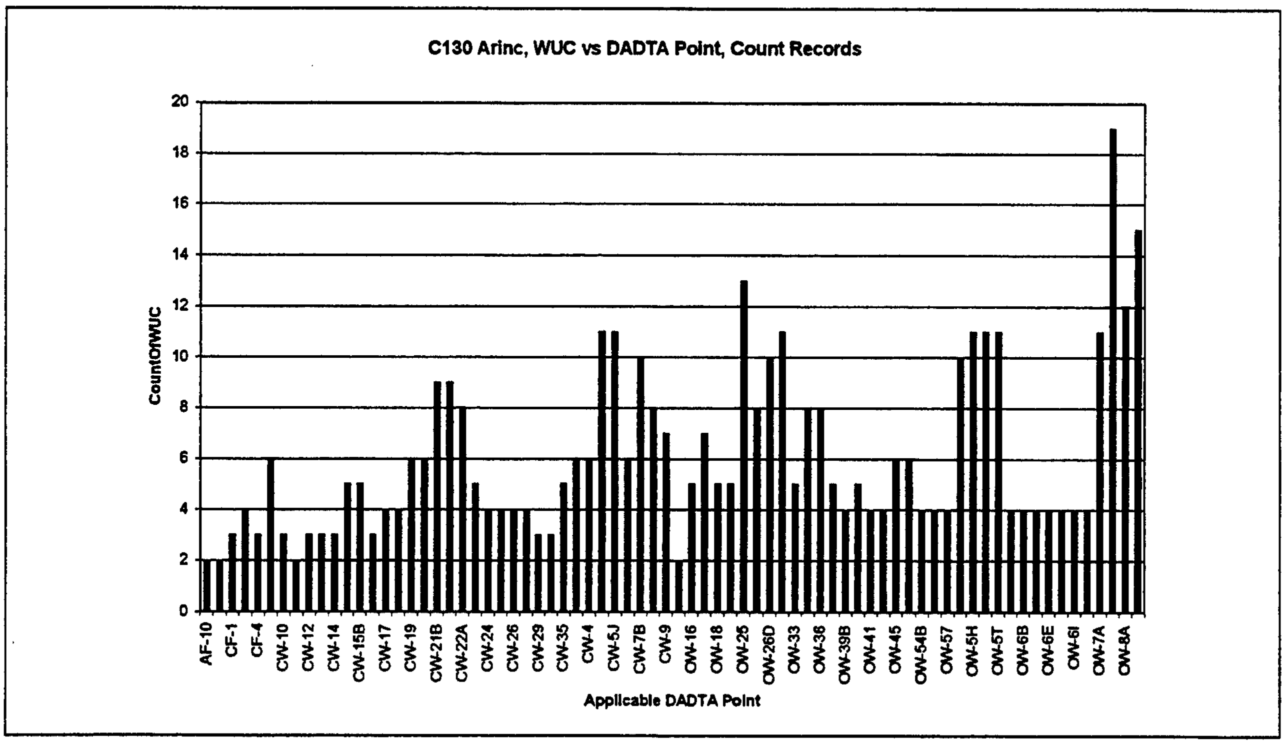


Figure 3.40 C130 ARINC, WUC Vs DADTA Point, a) Count Applicable DADTA Points for each Work Unit Code (WUC), and b) Count Work Unit Codes (WUC) for each Applicable DADTA Point.

Table 3.25 C130 OACIS, Count Records grouped by WUC for Tail Number 55-0022 and list of Applicable Number of DADTA Points.

OACIS, Tail#=55-0022,WUC, Count Records

Sum = 33 18 72

Work Unit Code	CountOfRecord	Number of Applicable DADTA Points	Records counted for DADTA Points
04185	1	0	0
04199	1	0	0
11000	4	0	0
113CG	1	0	0
11424	1	0	0
11432	2	0	0
11514	1	0	0
1151U	5	11	55
1151Y	3	5	15
1156A	1	2	2
11ECG	1	0	0
11GFA	1	0	0
11GFB	1	0	0
11LHA	1	0	0
12399	1	0	0
1431Q	1	0	0
14424	1	0	0
1751W	1	0	0
411AJ	1	0	0
46115	3	0	0
5301	1	0	0

3.4.1 C-130 Hercules - OACIS

Table 3.26 lists all the queries in the C-130 OACIS database (C130OACIS.mdb). The first group of OACIS queries is intended to identify general trends in the data concerning corrosion and cracking. First, the OACIS database was queried to separate the corrosion and cracking damage records from others contained in the database by counting records grouped by How-Malfunction code (H/M). The results from this query are presented in Table 3.27. Note that of the 8065 total records in the OACIS database, corrosion and cracking account for 90%. In OACIS, corrosion is recorded as severe (H/M=667) or mild (H/M=170) while cracking (H/M=190) has no associated degree of damage. The largest group is severe corrosion at 63% which was anticipated since OACIS archives only those records of repairs that exceed a PDM contact authorization level.

Next, a query was performed that counted records grouped by tail number where the H/M codes identified corrosion (667 or 170) or cracking (190). These tail numbers use a format, which includes the year the aircraft was delivered to the USAF (usually the same year the aircraft production was completed). The query results are presented in Figure 3.41. Note that there are three aircraft each with record counts that are at least twice as high as any other aircraft. The three aircraft grouped with the highest record counts were all delivered in 1977 (as indicated by the "77-" part of the tail number). This anomaly could be further evaluated to identify the unique characteristics (i.e. location, material, mission, etc.) of these aircraft that caused the higher than average corrosion occurrences for these three aircraft.

Next, several queries were performed that counted records grouped by work area code (W/A) and work unit code (WUC) where the H/M code is 667, 170, 190. The W/A codes identify a specific location on the airframe where inspections and repair work are performed. The definitions of the W/As for the C-130 are listed in Table 2.18. Note that work zones (W/Z) are available in OACIS and some queries were performed for W/Zs but the definitions were not gathered for this program. The WUC identifies a specific set of work instructions for specific components and locations. The definitions of the WUCs for the C-130 were not gathered for this effort. Table 3.28 and Figure 3.42

present the query results grouped by work area code. Note that the group of records with the highest count is for a blank in the W/A field (data not entered). The work area codes with the top three record counts are 19, 9, and 3, which are identified with Table 2.18 as center wing, right main landing gear wheel well, and aft fuselage station 737 through 1041 respectively. These three W/A codes account for 33% of the records that have a W/A code. Table 3.29 and Figure 3.43 present the query results grouped by work unit code. The WUCs with the top two record count values are 1143C and 1151Z. With 1439 unique WUCs in the OACIS database, these two WUCs account for only 6% of the 7232 records with corrosion and cracking damage.

In order to identify specific PSEs with high record count values, several queries were performed that counted records grouped by a selected PSE key word that was found in the discrepancy text field. The Pareto trend developed from these queries is shown in Table 3.30. The five PSE key words listed account for about one third of the 7232 records found with corrosion and cracking damage. Of the 2313 records identified by a PSE key word, 1430 (62%) were grouped by the "skin" PSE key word. Note that the "skin" PSE key word includes "panel" and "plank".

The location of the 5 PSE types identified in Table 3.30 can also be determined by several cross-tab queries with work area code. Table 3.31 identifies the top five or six work areas for each of the 5 PSE key words. For the "skin PSEs, the largest work area groups, other than blank, are the center wing section followed by fuselage sections from body station 245 to 737. For the "beam" PSEs, the largest work area groups are the left and right main landing gear and wheel well.

The final set of queries involves linking the ARINC database tables of WUC versus DADTA points and WUC Descriptions to the repair records in the OACIS database. This will identify the DADTA points found with corrosion and cracking damages. First, a query was performed that counted corrosion and cracked records grouped by tail number where the WUC has an associated DADTA point. Figure 3.45 displays the results from this query. This query is comparable to that shown in Figure 3.41 which counted all corrosion and cracked records. A comparison of these two queries indicates that overall there are 4 times more records without an associated DADTA point than records with a DADTA point. These comparisons are presented in

Table 3.32. This indicates that general airframe PSEs seem to drive the corrosion repair rates much higher then the airframe DADTA structural element.

The next seven queries are intended to identify the locations of the DADTA points found with corrosion and cracking damage. Some of these queries will also serve to verify the trends reported by ARINC in Reference [21] and to provide quantification of for the ranking trends. Table 3.33 presents the query results that counted records grouped by work area code for those WUCs with an associated DADTA point. These results are comparable to those in Table 3.28. The work area with the highest record count value is same for all the structural elements and just the DADTA points (W/A = 19, center wing). The top six work area codes (excluding blanks) identified in Table 3.33 are all wing structural elements. Table 3.34 presents the query results that counted corrosion and cracked records grouped by WUC with DADTA points. Compare these results with those in Table 3.29. Note that the top two WUC in Table 3.34 (115BB and 115CE) have four time more records than those in Table 3.29 which includes all records. As discussed in Section 3.4, this is an example of the inflated values that can occur when linking OACIS to the table of WUC versus DADTA points.

Table 3.35 presents the query results that counted records grouped by the WUC with an associated DADTA point, the associated DADTA point, and the major section of the DADTA point. Linking OACIS with the table of WUC versus DADTA points and the table of WUC descriptions developed this query. As another example of the discussion in Section 3.4, It can be seen in Table 3.35 that a DADTA point can be associated with several WUCs and several major sections. For example, DADTA point CW-10 is associated with WUC 115BB and 115CE while also listed for outer wing and center wing. Table 3.36 presents the same data as that in Table 3.35 but in this case the data is just grouped by the applicable DADTA points. Table 3.37 presents the data grouped by the applicable DADTA points and the associated major sections. Table 3.38 presents the data just grouped by the major section containing the DADTA points. The query results in Tables 3.36 and 3.38 are comparable to the results presented in Reference [21] but with the addition of the record count values to support the ranking. The rankings in Reference [21] and those presented here yield nearly the same ranking trends.

Using the C-130 OACIS database, cracking is not a high driver of repairs for the aircraft. Severe corrosion of the general PSE types identified above account for a much larger group of the repairs. To better identify PSEs with corrosion and cracking, a series of queries could be performed searching for records with a broader selection of PSE key words to identify more PSE groups. For those general PSEs identified above, "skin" structural elements have the highest count of repair records. These "skin" PSEs are located primarily in the center wing followed by the fuselage sections from body station 245 to 737. For the DADTA points, the dominant locations are on the wings.

Table 3.26 List of Queries Contained in the C-130 OACIS Database (C130OACIS.mdb).

Name of Queries in C130OACIS.mdb
C130 OACIS, How Mal, count records
C130 OACIS, Tail #, 667&170&190, count records
C130 OACIS, Tail #, 667&170&190, Ct Rec. w/ Discrep *beam*
C130 OACIS, Tail #, 667&170&190, Ct Rec. w/ Discrep *frame*
C130 OACIS, Tail #, 667&170&190, Ct Rec. w/ Discrep *longeron*
C130 OACIS, Tail #, 667&170&190, Ct Rec. w/ Discrep *skin*
C130 OACIS, Tail #, 667&170&190, Ct Rec. w/ Discrep *stringer*
C130 OACIS, Tail #, 667&170&190, Discrep w/ *beam*
C130 OACIS, Tail #, 667&170&190, Discrep w/ *frame*
C130 OACIS, Tail #, 667&170&190, Discrep w/ *longeron*
C130 OACIS, Tail #, 667&170&190, Discrep w/ *skin*
C130 OACIS, Tail #, 667&170&190, Discrep w/ *stringer*
C130 OACIS, Tail #, 667&170&190, WUC w/ DADTA, count records
C130 OACIS, W/A 2, Z, 667&170&190, Ct Rec. w/ Discrep *skin*
C130 OACIS, W/A 2, Z, 667&170&190, Tail #, Discrep w/ *skin*
C130 OACIS, Work Area 19, Zone, 667&170&190, count records
C130 OACIS, Work Area, 667&170&190, count
C130 OACIS, Work Area, 667&170&190, Ct Rec. w/ Discrep *beam*
C130 OACIS, Work Area, 667&170&190, Ct Rec. w/ Discrep *frame*
C130 OACIS, Work Area, 667&170&190, Ct Rec. w/ Discrep *longeron*
C130 OACIS, Work Area, 667&170&190, Ct Rec. w/ Discrep *skin*
C130 OACIS, Work Area, 667&170&190, Ct Rec. w/ Discrep *stringer*
C130 OACIS, WUC w/DADTA, 667&170&190, Ct Records
C130 OACIS, WUC w/DADTA, MSect, 667&170&190, count records
C130 OACIS, WUC w/DADTA, MSect, 667&170&190, count records 2
C130 OACIS, WUC w/DADTA, MSect, 667&170&190, count records 3
C130 OACIS, WUC, 667&170&190, count records

Table 3.27 C-130 OACIS, Count Records Grouped by How Malfunction Code (How Mal).

C130 OACIS, How Mal, count records

Sum = 8065

How Mal Code	Description	CountOfRecord
667	Corroded Severe	5109
170	Corroded Mild/Moderate	2035
0		258
799		99
190	Cracked	88
105	Loose, damaged, or missing hardware	80
804		80
710	Bearing failure	51
800		51
553	Does not meet specifications	40
425		18
585	Sheared	15
846	Delaminated	13
865	Deteriorated	13
230		12
70	Broken	10
20	Worn, Chaffed, frayed, or torn	7
66		5
801		5
242		5
381		5
730		5
127		4
750		4
67		3
661		3
844		3
567		2
410		2
780		2
802		2
107		2
932		2
99		2
662		2
677		2
Other codes w/ only one occurance each		26

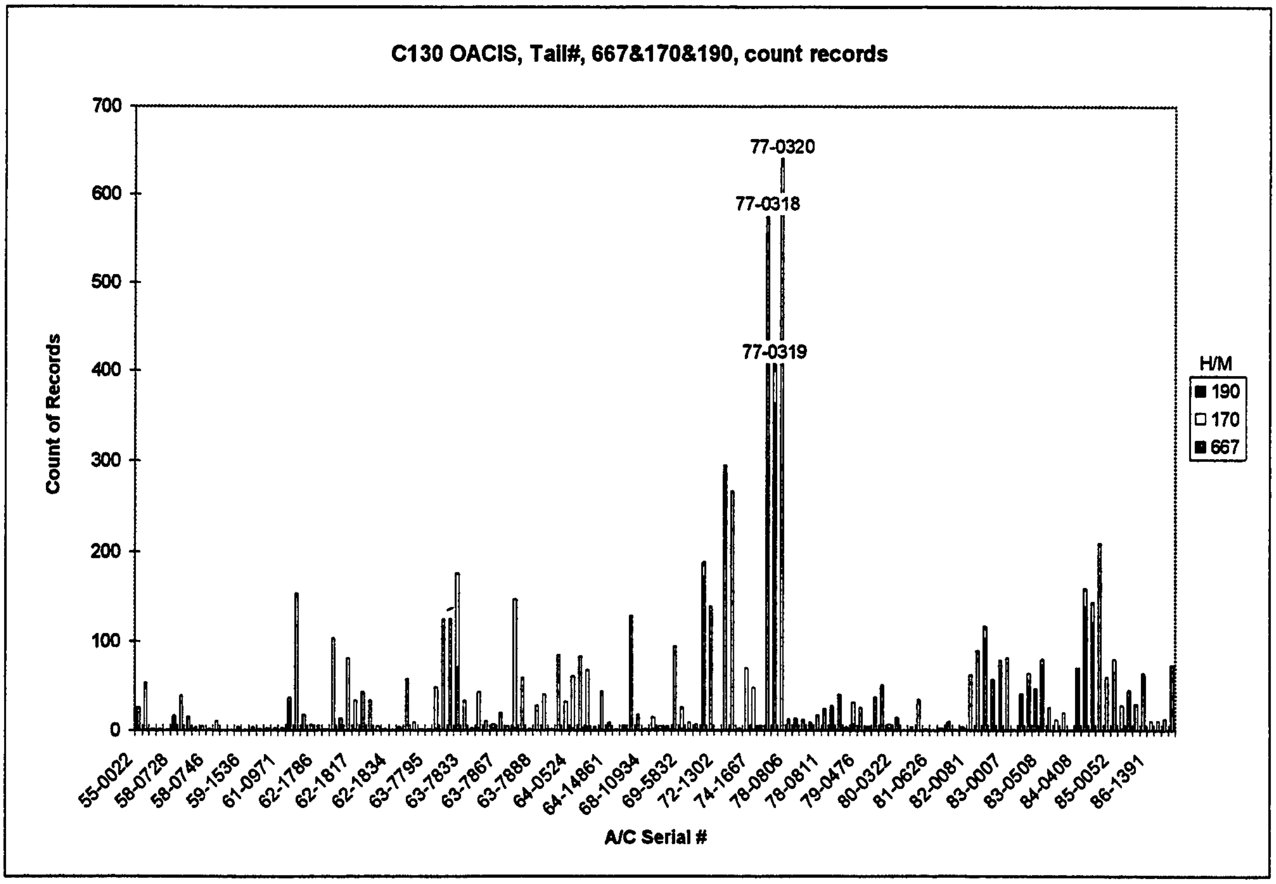


Figure 3.41 C-130 OACIS, Count Records Grouped by Aircraft Serial Number where the How Malfunction Code (H/M) is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or 190 (Cracking).

Table 3.28 C-130 OACIS, Count Records Grouped by Work Area Code where the How Malfunction Code (H/M) is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or 190 (Cracking).

C130 OACIS, Work Area, 667&170&190, count records
Only Total Counts > 14 plotted
Sum = 5109 2035 88 7232

H/M
Count of Records

Work Area	667	170	190	Sum
	67	1120	4	1191
19	722	90	13	825
9	513	41	8	562
3	371	168	5	544
10	485	28	11	524
2	376	132	6	514
14	384	48	2	434
7	290	22	4	316
5	273	38	3	314
6	267	27	4	298
4	238	39	8	285
5/7	170	42	2	214
13	176	25	4	205
4/6	153	39	4	196
11	123	20	2	145
12	88	18		106
1	38	21	1	60
15	35	15	1	51
12/13	30	20		50
17	44	4		48
18	35	10	1	46
16	35	10		45
4-6	23	12	1	36
6/7	18	7		25
11B	18	1		19
5-7	3	12		15
8	11	2	1	14
4,6	11		1	12
11A	9	1		10
Other Codes w/ sums < 10	103	23	2	128

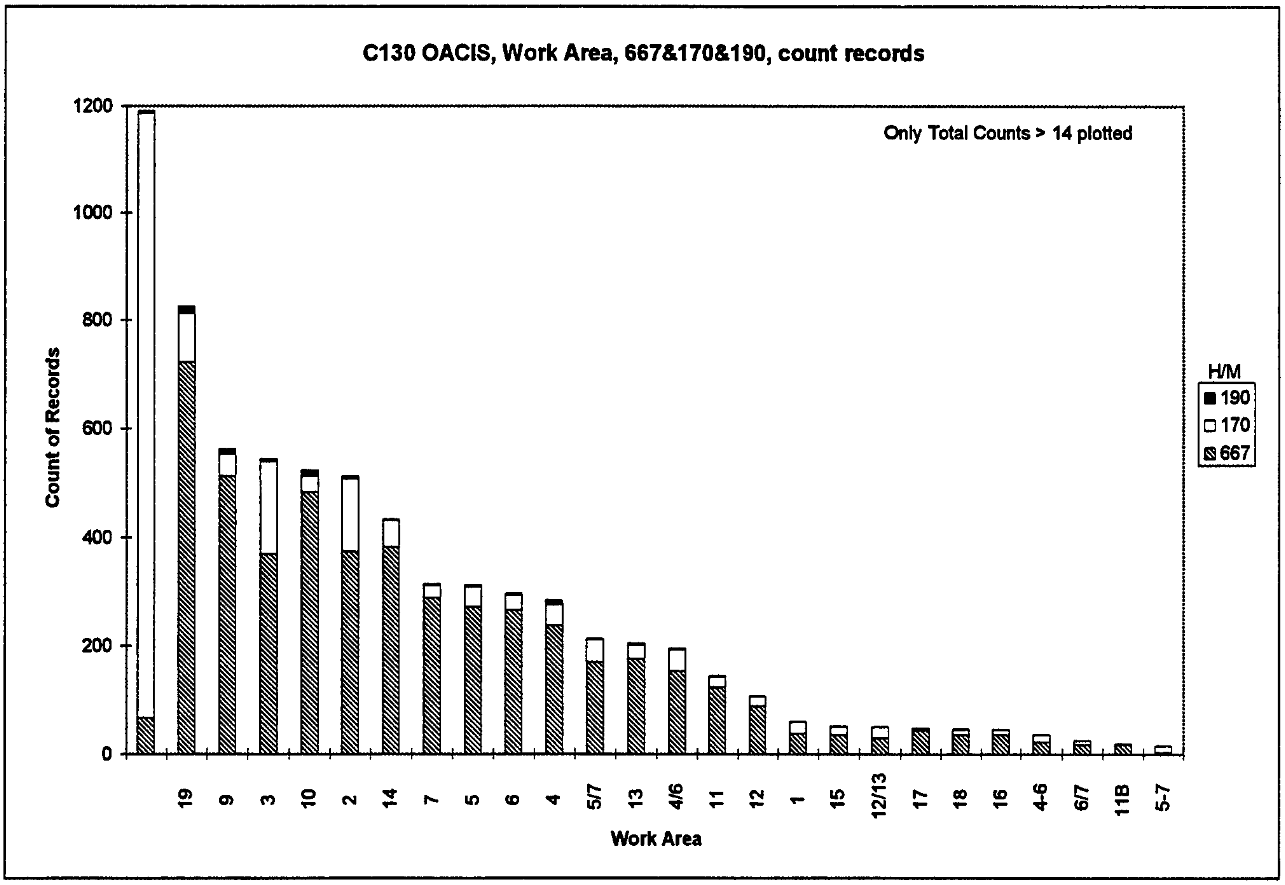


Figure 3.42 C-130 OACIS, Count Records Grouped by Work Area Code where the How Malfunction Code (H/M) is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or 190 (Cracking) (Only sums > 14 shown).

Table 3.29 C-130 OACIS, Count Records Grouped by Work Unit Code (WUC) where the How Malfunction Code (H/M) is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or 190 (Cracking).

C130 OACIS, WUC, 667&170&190, count records
Only Total Counts > 60 plotted

Sum =	5109	2035	88	7232

H/M
Count of Records

Work Unit Code	667	170	190	Sum
1143C	231	14	4	249
1151Z	151	27		178
11426	117	1	2	120
11512	80	38	1	119
11432	109	2	2	113
11240	106	7		113
1152Q	97	15		112
11541	43	62		105
1143D	93	2	1	96
22CAC	25	68		93
1154Y	73	3	11	87
1155E	83		1	84
114FL	74	4	4	82
11435	66	14		80
1441S	69	6	3	78
11525	45	27	2	74
114FJ	66	3	3	72
1441T	66	3		69
115BB	63	2	1	66
115CE	61	2	1	64
11431	56	8		64
1143L	55	8	1	64
1143M	57	4	1	62
115BT	48	4	2	54
11515	44	10		54
22CAD		53		53
114FM	49	3		52
1421K	26	24	1	51
114FA	39	9		48
11610	28	19		47
1152R	35	10		45
11540	27	17	1	45
114F3	42		1	43
114FK	37	5		42
114F1	30	10		40
114GA	32	5		37
1431Q	28	9		37
11400	3	33	1	37
11544	33	2		35
Other Codes w/ Counts < 30	2722	1502	44	4268

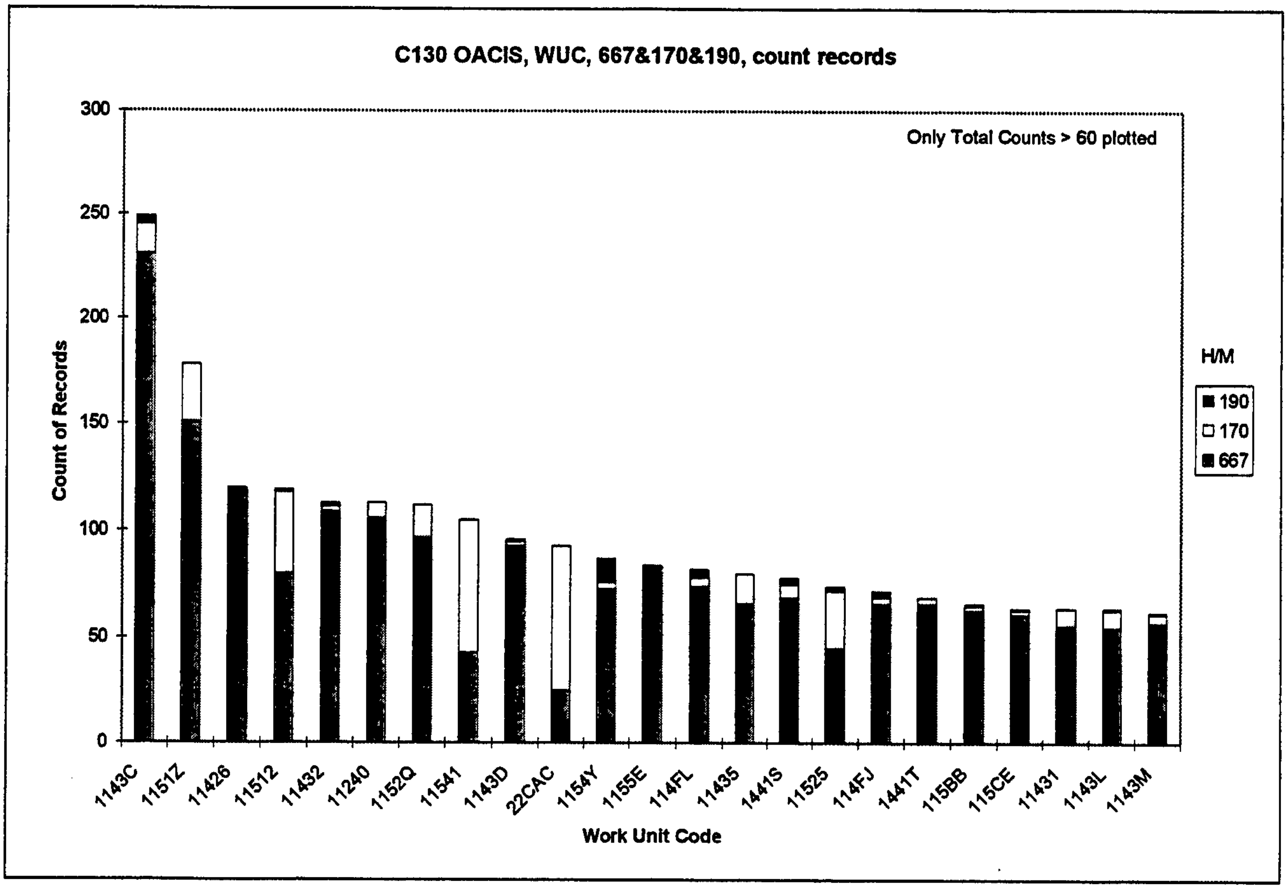


Figure 3.43 C-130 OACIS, Count Records Grouped by Work Unit Code (WUC) where the How Malfunction Code (H/M) is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or 190 (Cracking).

Table 3.30 C-130 OACIS, Count of Records Grouped by a Selected PSE Key Word in the Discrepancy Text Field where How Malfunction Code (H/M) is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or 190 (Cracking).

C130 OACIS, 667&170&190, Ct Records w/ Discrep *?*

Count of Records

Discrepancy w/	170	667	190	Sum
Sum	641	1641	31	2313
skin	559	857	14	1430
beam	43	414	13	470
longeron	30	241	3	274
frame	8	106		114
stringer	1	23	1	25

Table 3.31 C-130 OACIS, Count of Records Grouped by Work Area Code Cross Tabbed by a Selected PSE Key Word in the Discrepancy Text Field and where How Malfunction Code (H/M) is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or 190 (Cracking).

C130 OACIS, Work Area, 667&170&190, Ct Rec w/ Discrep *?*

Only Top 5 W/A's for each part type shown

Count of Records

Work Area	Description	skin	beam	longeron	frame	stringer	Sum
Sum		1071	417	207	72	24	1791
Blank		403					403
9	R. main gear & wheel well	75	164			5	244
2	Fuselage, Sta 245 - 737	129		61	15	1	206
10	L. main gear & wheel well		169	13		12	194
19	Center wing	158		13	16	3	190
3	Aft fuselage Sta 737 - 1041	116				3	119
5	Top of L. wing	100			8		108
4	Top of R. wing	90					90
14	Aft Cargo, Sta 737 - 1041			88			88
11	Flight deck		22		26		48
7	Bottom of L. wing		33				33
13	Cargo, Sta 477 - 737			32			32
6	Bottom of R. wing		29				29
1	Nose, Sta 0 - 245				7		7

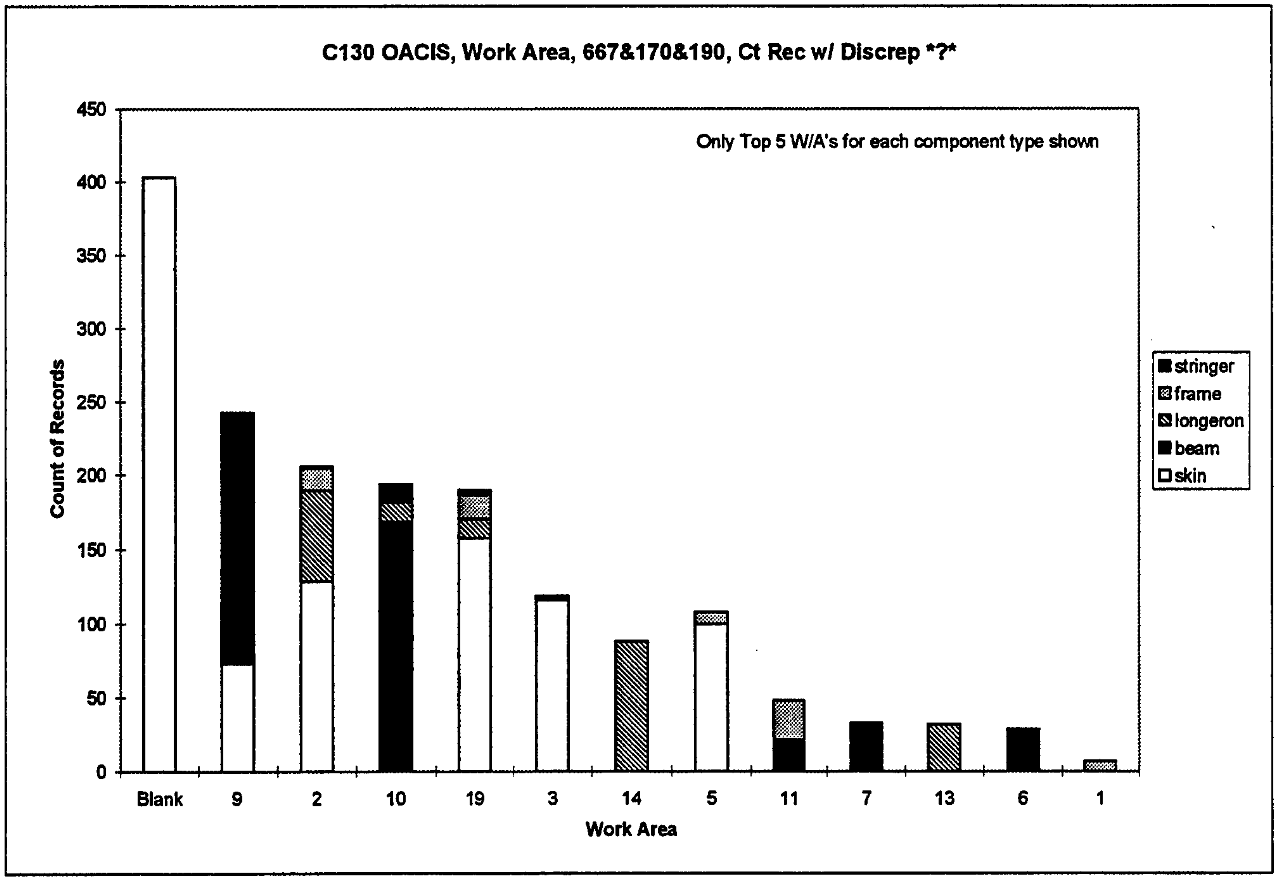


Figure 3.44 C-130 OACIS, Count of Records Grouped by Work Area Code Cross Tabbed by a Selected PSE Key Word in the Discrepancy Text Field and where How Malfunction Code (H/M) is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or 190 (Cracking).

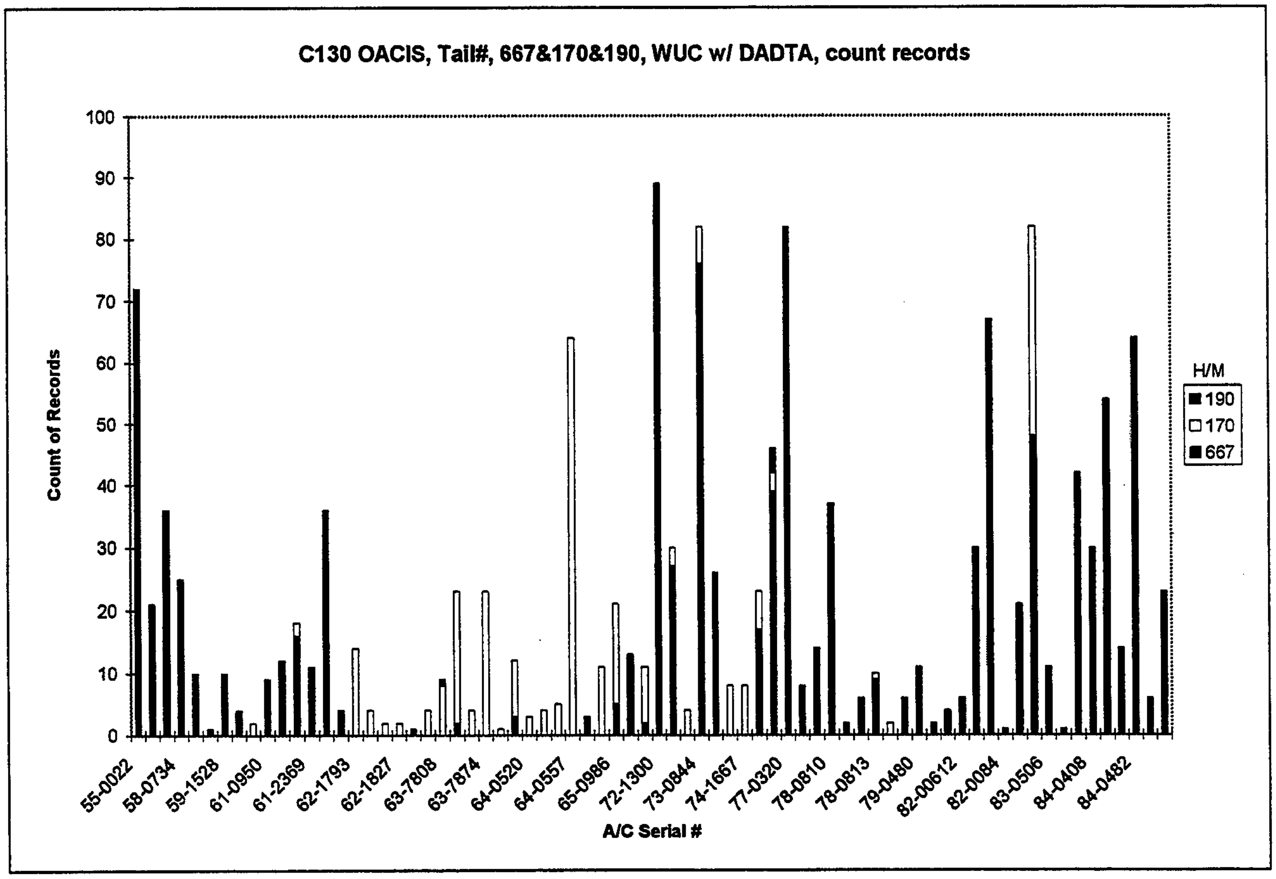


Figure 3.45 C-130 OACIS, Count Records Grouped by Aircraft Serial Number where the WUC has an Associated DADTA Point and where the How Malfunction Code (H/M) is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or 190 (Cracking).

Table 3.32 C-130 OACIS, Comparison of Record Counts without DADTA Points to Those with DADTA Points.

	H/M Code			
	Sum of Records			
Query Name	667	170	190	667+170
C130 OACIS, Tail#, 667&170&190, count records	5109	2035	88	7144
C130 OACIS, Tail#, 667&170&190, WUC w/ DADTA, count records	1143	283	31	1426
Ratio of records w/o DADTA points to Records w/ DADTA points	3.47	6.191	1.839	4.009818

Table 3.33 C-130 OACIS, Count of Records Grouped by Work Area Code (W/A) for WUCs with a DADTA Point and where the How Malfunction Code (H/M) is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or 190 (Cracking).

C130 OACIS, Work Area, WUC w/DADTA, 667&170&190, count records

Sum =	1143	283	31	1457

H/M

Count of Records

Work Area	667	170	190	Sum
19	523	45	8	576
6	179	16	9	204
7	178	12	11	201
	7	115	1	123
5	26	52		78
4/6	37			37
4-6	35			35
14	29	5		34
2	5	21		26
4	23	2		25
3	20	4		24
13	17	1	1	19
4,6	18			18
5/7	13		1	14
6/7	8			8
13,19		5		5
13/19		5		5
19,6	4			4
19/7	4			4
4/6/5/	4			4
9	4			4
XX	4			4
3/14	2			2
14/3	1			1
17	1			1
419	1			1

Table 3.34 C-130 OACIS, Count of Records Grouped by Work Unit Codes (WUC) with a DADTA Point and where the How Malfunction Code (H/M) is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or 190 (Cracking).

C130 OACIS, WUC w/DADTA, 667&170&190, Ct Records 2

Sum	1143	283	31	1457

H/M
Count of Records

WUC	667	170	190	Sum
115BB	252	8	4	264
115CE	244	8	4	256
11570	80	96		176
1151U	55	11	11	77
1152A	60	10		70
115CB	63		3	66
11560	36	18		54
115BD	48			48
114GA	32	5		37
1151W	30			30
115BF	26	1	1	28
115CA	28			28
1151Y	20		5	25
115CF	20			20
115BA	18			18
1157F	12			12
11WDE	10	2		12
114FB	11			11
114FD	8	1	1	10
115BC	10			10
Other WUC's w/ Sums < 10	80	123	2	205

Table 3.35 C-130 OACIS, Count of Records Grouped by the Work Unit Code (WUC) with a DADTA Point, the Applicable DADTA Point, and the Major Section where the How Malfunction Code (H/M) is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or 190 (Cracking).

C130 OACIS, WUC w/DADTA, MSect, 667&170&190, count records

Sum			1143	283	31	1457
			H/M Count of Records			
Work Unit Code	Applicable DADTA Point	Major Section	667	170	190	Sum
115BB	CW-10	Outer Wing	63	2	1	66
115BB	CW-11	Outer Wing	63	2	1	66
115BB	CW-9	Outer Wing	63	2	1	66
115BB	OW-3	Outer Wing	63	2	1	66
115CE	CW-10	Center Wing	61	2	1	64
115CE	CW-11	Center Wing	61	2	1	64
115CE	CW-9	Center Wing	61	2	1	64
115CE	OW-3	Center Wing	61	2	1	64
114GA	AF-4B	Fuselage	32	5		37
115BF	OW-52	Outer Wing	26	1	1	28
115CA	OW-45	Center Wing	28			28
115CB	CW-12	Center Wing	21		1	22
115CB	CW-8	Center Wing	21		1	22
115CB	OW-36	Center Wing	21		1	22
115CF	OW-25	Center Wing	20			20
115BA	OW-25	Outer Wing	18			18
115BD	CW-12	Outer Wing	16			16
115BD	CW-8	Outer Wing	16			16
115BD	OW-36	Outer Wing	16			16
1152A	CW-17	Center Wing	12	2		14
1152A	CW-18	Center Wing	12	2		14
1152A	CW-25	Center Wing	12	2		14
1152A	CW-26	Center Wing	12	2		14
1152A	CW-27	Center Wing	12	2		14
114FB	CF-3	Fuselage	11			11
11570	CW-1	Center Wing	5	6		11
11570	CW-19	Center Wing	5	6		11
11570	CW-20	Center Wing	5	6		11
11570	CW-21B	Center Wing	5	6		11
11570	CW-21E	Center Wing	5	6		11
11570	CW-22A	Center Wing	5	6		11
11570	CW-23	Center Wing	5	6		11
11570	CW-24	Center Wing	5	6		11
11570	CW-3A	Center Wing	5	6		11
11570	CW-4	Center Wing	5	6		11
11570	CW-5C	Center Wing	5	6		11
11570	CW-5J	Center Wing	5	6		11
11570	CW-6	Center Wing	5	6		11
11570	CW-7B	Center Wing	5	6		11
11570	CW-8	Center Wing	5	6		11
11570	CW-9	Center Wing	5	6		11
114FD	CF-4	Fuselage	8	1	1	10
115BC	OW-45	Outer Wing	10			10
Other WUC's w/ Sums < 10			243	154	18	415

Table 3.36 C-130 OACIS, Count of Records Grouped by Applicable DADTA Points Associated with the Work Unit Code (WUC) where How Malfunction Code (H/M) is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or 190 (Cracking).

C130 OACIS, WUC w/DADTA, 667&170&190, Ct Records

	H/M Count of Records			
Sum	1143	283	31	1457
Applicable DADTA Point	667	170	190	Sum
CW-9	131	12	2	145
OW-3	126	5	2	133
CW-10	124	4	2	130
CW-11	124	4	2	130
CW-8	44	8	1	53
OW-52	44	1	2	47
OW-36	42	1	2	45
OW-25	40	4		44
OW-45	40	1		41
CW-12	37		1	38
AF-4B	32	5		37
CW-19	6	23	1	30
CW-20	8	15		23
CW-24	5	18		23
CW-5C	9	13		22
CW-22A	11	10		21
CW-1	13	6	1	20
CW-21B	10	10		20
CW-21E	10	10		20
OW-7D	2	16		18
CW-25	15	2		17
CW-26	15	2		17
CW-27	15	2		17
CW-17	14	2		16
CW-18	14	2		16
CW-5J	9	7		16
CW-7B	7	9		16
CW-23	5	10		15
CW-6	7	7		14
CF-3	13			13
CF-4	11	1	1	13
CW-3A	7	6		13
CW-4	7	6		13
OW-26B	6	7		13
OW-26D	6	7		13
OW-54B	10		1	11
OW-56	10		1	11
OW-57	10		1	11
OW-6M	10		1	11
Other DADTA points w/ Sums < 10	94	47	10	151

Table 3.37 C-130 OACIS, Count of Records Grouped by the Applicable DADTA Point Associated with the Work Unit Code (WUC) and the Major Section where How Malfunction Code (H/M) is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or 190 (Cracking).

C130 OACIS, WUC w/DADTA, MSect, 667&170&190, count records 2

		H/M Count of Records			
Sum		1143	283	31	1457
Applicable DADTA Point	Major Section	667	170	190	Sum
CW-9	Center Wing	68	10	1	79
OW-3	Outer Wing	65	3	1	69
CW-10	Outer Wing	63	2	1	66
CW-11	Outer Wing	63	2	1	66
CW-9	Outer Wing	63	2	1	66
CW-10	Center Wing	61	2	1	64
CW-11	Center Wing	61	2	1	64
OW-3	Center Wing	61	2	1	64
OW-52	Outer Wing	36	1	2	39
AF-4B	Fuselage	32	5		37
CW-8	Center Wing	28	8	1	37
CW-19	Center Wing	6	23	1	30
OW-45	Center Wing	28			28
OW-25	Outer Wing	20	4		24
CW-20	Center Wing	8	15		23
CW-24	Center Wing	5	18		23
OW-36	Outer Wing	21	1	1	23
CW-12	Center Wing	21		1	22
CW-5C	Center Wing	9	13		22
OW-36	Center Wing	21		1	22
CW-22A	Center Wing	11	10		21
CW-1	Center Wing	13	6	1	20
CW-21B	Center Wing	10	10		20
CW-21E	Center Wing	10	10		20
OW-25	Center Wing	20			20
OW-7D	Outer Wing	2	16		18
CW-25	Center Wing	15	2		17
CW-26	Center Wing	15	2		17
CW-27	Center Wing	15	2		17
CW-12	Outer Wing	16			16
CW-17	Center Wing	14	2		16
CW-18	Center Wing	14	2		16
CW-5J	Center Wing	9	7		16
CW-7B	Center Wing	7	9		16
CW-8	Outer Wing	16			16
CW-23	Center Wing	5	10		15
CW-6	Center Wing	7	7		14
CF-3	Fuselage	13			13
CF-4	Fuselage	11	1	1	13
CW-3A	Center Wing	7	6		13
CW-4	Center Wing	7	6		13
OW-26B	Outer Wing	6	7		13
OW-26D	Outer Wing	6	7		13
OW-45	Outer Wing	12	1		13
OW-54B	Outer Wing	10		1	11
OW-56	Outer Wing	10		1	11
OW-57	Outer Wing	10		1	11
OW-6M	Outer Wing	10		1	11
Other DADTA points w/ Sums < 10		102	47	10	159

Table 3.38 C-130 OACIS, Count of Records Grouped by Major Section of Applicable DADTA Points Associated with WUCs where How Malfunction Code (H/M) is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or 190 (Cracking).

C130 OACIS, WUC w/DADTA, MSect, 667&170&190, count records 3

Sum	1143	283	31	1457

H/M

Count of Records

Major Section	667	170	190	Sum
Center Wing	570	184	9	763
Outer Wing	512	86	21	619
Fuselage	58	9	1	68
Nacelle A	1	2		3
Nacelle D	1	2		3
Nacelle C	1			1

3.4.2 C-130 Hercules - AFMC-202

Table 3.39 list all the queries in the C-130 AFMC-202 Access database (C130AFMC202.mdb). The first group of AFMC202 queries is intended to identify general trends in the data concerning corrosion and cracking. The contents and definitions of the AFMC202 database are described in Table 2.15. First, the AFMC202 database was queried to separate the records for corrosion and cracking damage from others contained in the database. This was achieved by counting records grouped by the Damage Classification terms. Table 3.40 presents the results from this query. Note that of the 1003 records in the AFMC202 database, corrosion and crack account for 32%. Of these 320 records, 58% are attributed to corrosion damage. In AFMC202, damage due to corrosion and cracking has no associated degree of damage.

A query was performed that counted records grouped by tail number where the Damage Classification is corrosion or crack. The standard tail number use a format that incorporates the year the aircraft was delivered to the USAF (i.e. 64-14856). The results from this query are presented in Figure 3.46. Note that of the 320 total records counted, 43 are grouped by a tail number entered as a model design series (i.e. HC-130P ...) or some other non-standard tail number format. This data entry problem will not impact the trends indicated by these numbers.

Next, several queries were performed that counted the corrosion and crack records grouped by the part identification noun and location description terms. Some of these queries will also serve to verify the trends reported by ARINC in Reference [21] and to provide quantification for the ranking trends. Table 3.41 and Figure 3.47 presents the query results that counted records grouped by the part identification noun where the Damage Classification is corrosion or crack. The part nouns with the top two record count values are vertical beam and longeron. These part nouns are comparable to the PSE terms used in other database queries. Table 3.42 presents this same data but in this case the year the record was closed is indicated. Table 3.43 and Figure 3.48 presents the query results that counted records grouped by the location description terms. These location description terms define regions on the airframe where the damage was found. These terms are comparable to the work areas used in other

database. Note that the location terms with the top three record count values are Mid-Fuselage, Aft-Fuselage, and Center Wing. Mid-Fuselage accounts for about 30% of the 320 records attributed to corrosion and crack damage. Table 3.44 presents this same data but in this case the year the repair record was closed is indicated. Tables 3.41 and 3.44 yield a similar ranking compared to that which was reported by ARINC in Reference [21] plus these figures provide the record count values to justify the ranking.

Finally, a query was performed that counted records grouped by the part identification nouns cross-tabbed by the top three location description terms. Thus, the locations of the specific structural element parts found with corrosion or cracking damage are identified. Table 3.46 presents the results of a query that lists records for the part description noun with the highest record count value (vertical beam). Included are the locations of the repaired vertical beams and the deficiency test field for each record.

Based on the data in the AFMC202 database, damage due to corrosion exceeds damage due to cracks, but not by the factors identified with OACIS. The top three location description terms identified by the AFMC202 include the Mid-Fuselage, Aft-Fuselage, and Center Wing. The Top three part identification nouns identified include the vertical beams, longerons, and flap structural elements. The terms used to identify specific parts (nouns) are an added value over OACIS but the list is too long and subject to slight variations for the same part. The terms used to identify location of the damage are comparable to the work area codes used by OACIS.

Table 3.39 List of Queries in the C-130 AFMC-202 Access Database (C130AFMC202.mdb).

Name of Queries in C130AFMC202.mdb
C130 202, Damage Classif, Count Records
C130 202, Loc, corr & crack, Count Records
C130 202, Loc, Year, corr & crack, Count Records
C130 202, Noun, corr & crack, Count Records
C130 202, Noun, Loc, corr & crack, Count Records
C130 202, Noun, Year, corr & crack, Count Records
C130 202, SER#, corr & crack, Count Records
C130 202, SER#, Year, corr & crack, Count Records
C130 202, Top 3 Loc, noun, corr & crack, Count Records
C130 202, Top 3 Loc, noun, corr & crack, Deficiency
C130 202, Top 3 Noun & Loc, corr & crack, Count Records
C130 202, Top 3 Noun & Loc, corr & crack, Deficiency
C130 202, Top 3 Noun, Loc, corr & crack, Count Records
C130 202, Top 3 Noun, Loc, corr & crack, Deficiency

Table 3.40 C-130 AFMC-202, Count Records Grouped by Damage Classification.

C130 202, Damage Classif, Count Records

Sum 1003

Damage Classification	CountOfRecord
Corrosion	186
Crack	134
Misc Damage	115
Modification/Repair	96
Substitution	82
Alignment	40
Waiver	38
Damaged/Elongated Holes	38
Data	30
Damage Beyond Repair	29
Interference Problem	25
Damaged Holes	20
Edge Distance	17
Oversized Holes	17
Hardware	17
Dents/Oil Canning/Buckling	15
Improper Repair	12
Wear	11
Modification	11
Delamination	9
Wiring	8
Finish	7
Dents/Oil Canning	7
Scoring	7
Deformation	5
Rigging	4
Paint/Depaint/Wash	4
Improper Fit	3
Loose and/or Missing Fasteners	3
Malfunction	3
Weight & Balance	3
Elongated Holes	2
General Electrical	2
Misc	1
Shoring	1
Hole Damage	1

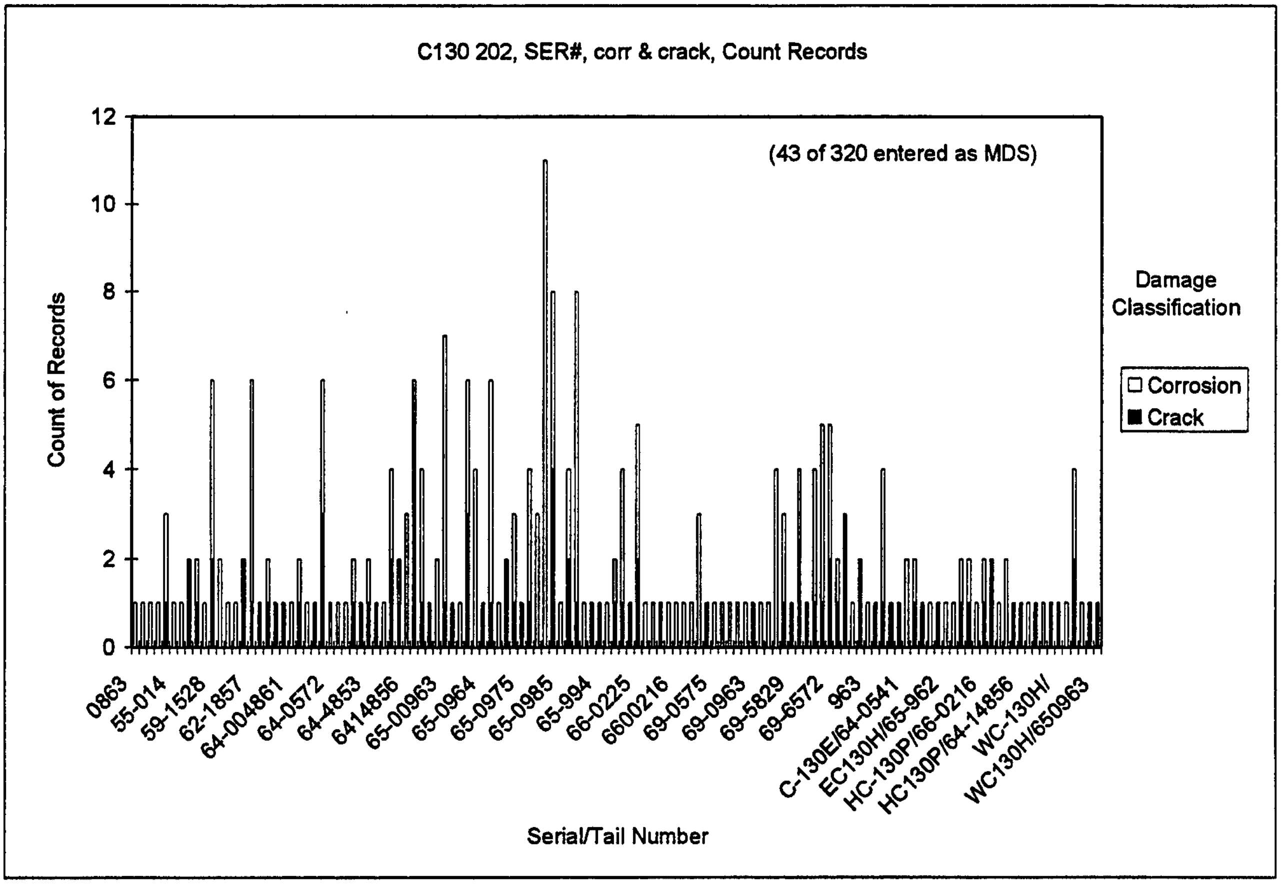


Figure 3.46 C-130 AFMC-202, Count Records Grouped by Aircraft Serial/Tail Number Where the Damage Classification is "Corrosion" or "Crack".

Table 3.41 C-130 AFMC-202, Count Records Grouped by Part Identification Noun Where the Damage Classification is "Corrosion" or "Crack".

C130 202, Noun, corr & crack, Count Records
Sum = 186 134 320

Damage Classification
Count of Records

Noun	Corrosion	Crack	Sum
Vertical Beam	18	11	29
Longeron	11	3	14
Flap	8		8
Truss Mount	6	1	7
Chine Plate	3	4	7
Vertical Stabilizer	1	6	7
Chine Angle	5	1	6
Angle	4	2	6
Cargo Ramp	4	2	6
Sloping Longeron	5		5
Radome	1	4	5
Oil Tank		5	5
Nacelle		5	5
Fitting	3	1	4
Bulkhead	3	1	4
Aileron	2	2	4
Horizontal Stabilizer	2	2	4
Vertical stab	3		3
Panel	3		3
Skin	2	1	3
Benson Tank	1	2	3
Ring Segment	1	2	3
Elevator		3	3
Main landing gear vertical beam		3	3
Fireseal		3	3
Air Inlet Scoop		3	3
Wing Panel	2		2
Dorsal Fin	2		2
Channel	2		2
Windshield frame	2		2
Pylon Tank	2		2
Rainbow Fitting	2		2
External tank	2		2
Duct	1	1	2
Inboard cap	1	1	2
Trailing edge panels	1	1	2
Ramp	1	1	2
Chine cap	1	1	2
MLG Vertical Beam	1	1	2
Spar Cap	1	1	2
Hat Channel	1	1	2
Attach fitting	1	1	2
Attach Angle	1	1	2
Dorsal Fin Attach Angle		2	2
Cap		2	2
Rib		2	2
Compensator		2	2
Beam cap		2	2
Tie fitting		2	2
Diffuser		2	2
119 other Nouns @ 1 each	76	43	119

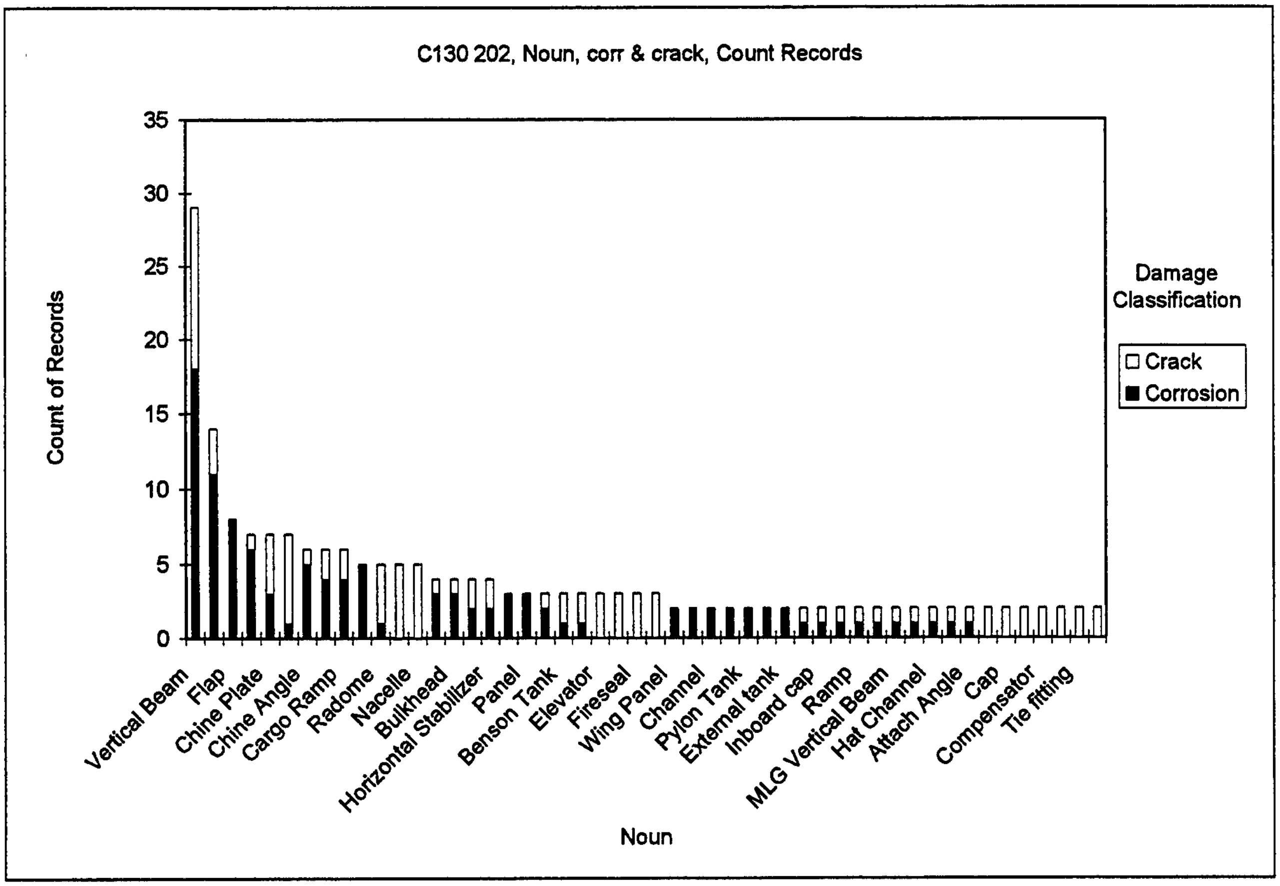


Figure 3.47 C-130 AFMC-202, Count Records Grouped by Part Identification Noun Where the Damage Classification is "Corrosion" or "Crack" (Only sums greater than 1 are shown).

Table 3.42 C-130 AFMC-202, Count Records Grouped by Part Identification Noun Cross-Tabbed by Year and Where the Damage Classification is "Corrosion" or "Crack".

C130 202, Noun, Year, corr & crack, Count Records

Sum = 129 177 14 320

Year
Count of Records

Noun	1994	1995	1996	Sum
Vertical Beam	13	16		29
Longeron	9	4	1	14
Flap	1	7		8
Chine Plate	3	3	1	7
Truss Mount	3	4		7
Vertical Stabilizer	4	3		7
Angle	3	3		6
Cargo Ramp	3	3		6
Chine Angle	1	5		6
Nacelle	1	4		5
Oil Tank	5			5
Radome	3	2		5
Sloping Longeron	2	2	1	5
Aileron	1	3		4
Bulkhead	2	2		4
Fitting	3	1		4
Horizontal Stabilizer	3	1		4
Air Inlet Scoop	3			3
Benson Tank	2		1	3
Elevator	2	1		3
Fireseal		3		3
Main landing gear vertical beam		3		3
Panel	1	2		3
Ring Segment	1	1	1	3
Skin	2	1		3
Vertical stab		2	1	3
Attach Angle	1	1		2
Attach Fitting		2		2
Beam cap		2		2
Cap	2			2
Channel	2			2
Chine cap		2		2
Compensator		1	1	2
Diffuser	1	1		2
Dorsal Fin	1	1		2
Dorsal Fin Attach Angle	1		1	2
Duct		2		2
External tank		1	1	2
Hat Channel		2		2
Inboard cap		2		2
MLG Vertical Beam	2			2
Pylon Tank	1	1		2
Rainbow Fitting	1	1		2
Ramp		2		2
Rib	1	1		2
Spar Cap	2			2
Tie fitting		2		2
Trailing edge panels		2		2
Windshield frame		2		2
Wing Panel		2		2
119 other Nouns @ 1 each	43	71	5	119

Table 3.43 C-130 AFMC-202, Count Records Grouped by Location Description Terms Where the Damage Classification is "Corrosion" or "Crack".

C130 202, Loc, corr & crack, Count Records

Sum =	186	134	320
Average =	6.888889	4.786	
	Damage Classification		
	Count of Records		
Location on Aircraft	Corrosion	Crack	Sum
Mid-Fuselage	56	36	92
Aft Fuselage	23	9	32
Center Wing	17	4	21
Main Landing Gear	10	7	17
Outer Wing	10	6	16
Forward Fuselage	10	4	14
Vertical Stabilizers	4	7	11
Nacelle	1	10	11
Cargo Ramp	7	3	10
OW Flaps	7	1	8
External Fuel Tanks/Pylon	6	2	8
Elevators	4	4	8
Horizontal Stabilizer	3	5	8
General Aircraft	5	2	7
Bleed Air		6	6
QEC		6	6
External Fuel Tanks	5		5
Ailerons	3	2	5
Nose Radome	1	4	5
Engine		5	5
CW Flaps	4		4
Benson Tanks	1	2	3
Nose Landing Gear	1	2	3
CW Trailing Edges	2		2
Rudder	1	1	2
Cargo Door	1		1
Heat/Air Conditioning System	1		1
VOR Antenna	1		1
Life Raft System	1		1
OW Trailing Edges	1		1
ADS		1	1
IR Pod		1	1
Paratroop Doors		1	1
APU		1	1
Propellers		1	1
Fuel System		1	1

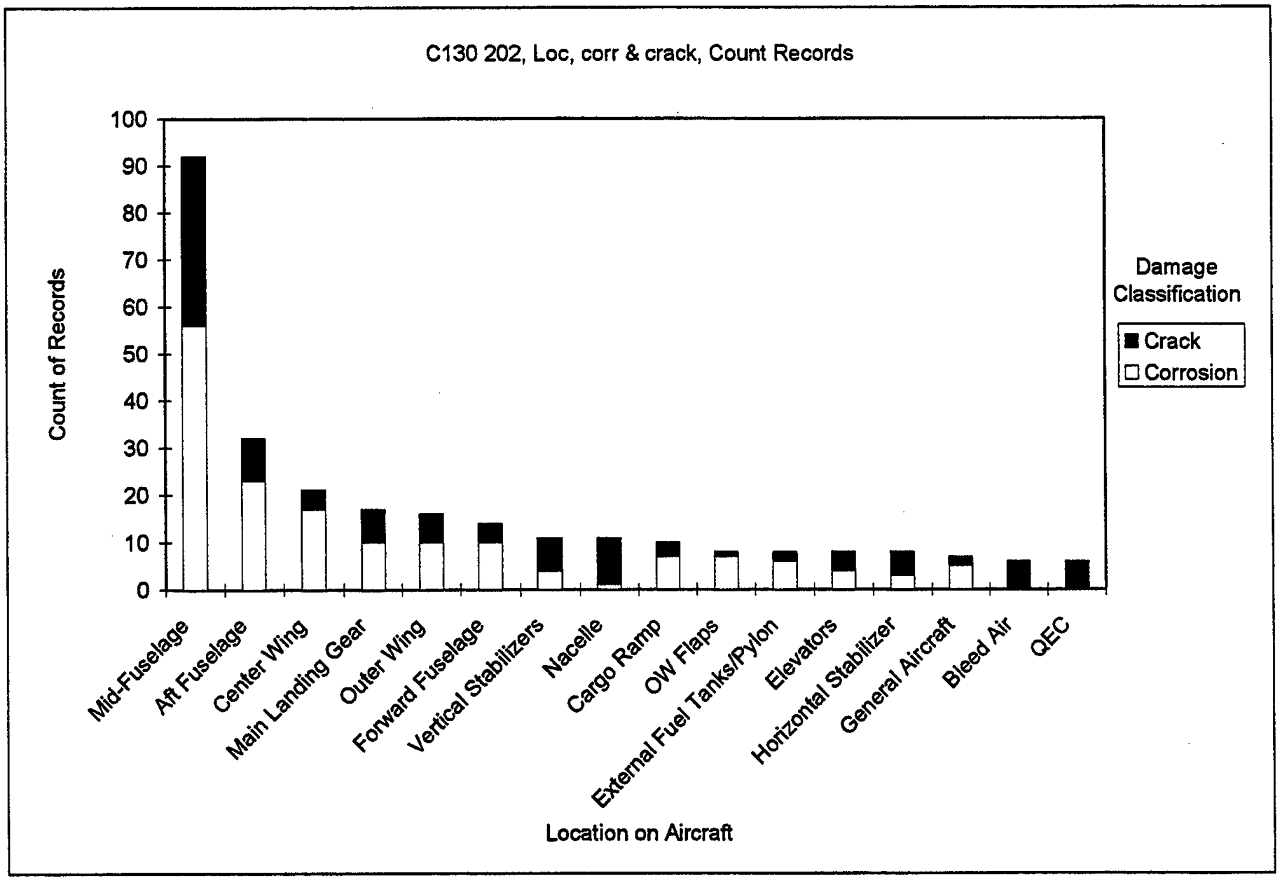


Figure 3.48 C-130 AFMC-202, Count Records Grouped by Location Description Terms Where the Damage Classification is "Corrosion" or "Crack" (Only sums > 5 shown).

Table 3.44 C-130 AFMC-202, Count Records Grouped by Location Description Terms Cross-Tabbed by Year and Where the Damage Classification is "Corrosion" or "Crack".

C130 202, Loc, Year, corr & crack, Count Records

Sum = 129 177 14 320

Year
Count of Records

Location on Aircraft	1994	1995	1996	Sum
Mid-Fuselage	32	54	6	92
Aft Fuselage	9	20	3	32
Center Wing	6	14	1	21
Main Landing Gear	16	1		17
Outer Wing	6	9	1	16
Forward Fuselage	4	10		14
Nacelle	8	3		11
Vertical Stabilizers	5	6		11
Cargo Ramp	4	6		10
Elevators	4	4		8
External Fuel Tanks/Pylon	2	6		8
Horizontal Stabilizer	3	5		8
OW Flaps	4	4		8
General Aircraft		7		7
Bleed Air	2	4		6
QEC		6		6
Ailerons	1	4		5
Engine	4	1		5
External Fuel Tanks	3	1	1	5
Nose Radome	3	2		5
CW Flaps	1	3		4
Benson Tanks	2		1	3
Nose Landing Gear	2	1		3
CW Trailing Edges	1	1		2
Rudder	2			2
ADS		1		1
APU	1			1
Cargo Door	1			1
Fuel System			1	1
Heat/Air Conditioning System		1		1
IR Pod		1		1
Life Raft System		1		1
OW Trailing Edges		1		1
Paratroop Doors	1			1
Propellers	1			1
VOR Antenna	1			1

Table 3.45 C-130 AFMC-202, Count Records Grouped by Part Description Nouns Cross-Tabbed by the Top Three Location Description Terms and Where the Damage Classification is "Corrosion" or "Crack".

C130 202, Top 3 Loc, Noun, corr & crack, Count Records

	Top 3 Locations			
Sum =	32	21	92	145
Noun	Aft Fuselage	Center Wing	Mid-Fuselage	Sum
Vertical Beam			17	17
Longeron	6		8	14
Chine Plate			7	7
Chine angle	1		5	6
Angle		1	4	5
Sloping Longeron	4		1	5
Bulkhead			3	3
Fitting	2		1	3
Main landing gear vertical beam			3	3
Ring segment	1		2	3
Beam cap			2	2
Channel	1		1	2
Chine cap			2	2
Dorsal Fin	2			2
Hat Channel	1	1		2
Inboard cap			2	2
Panel		1	1	2
Rainbow Fitting		2		2
Skin			2	2
Truss Mount		2		2
Vertical Stab	1		1	2
Attach Angle	1			1
Attach angle dorsal fin	1			1
Attach beam			1	1
BL 20 Longeron			1	1
Bulkhead Cap	1			1
Bulkhead end fitting	1			1
Bulkhead web			1	1
Cap			1	1
Cargo Floorboards			1	1
Center wing panel		1		1
Chine			1	1
Chine plate cap			1	1
Chineplate			1	1
CW Filler Panel		1		1
CW Filler Panels			1	1
Dorsal fin attach angle	1			1
Dorsal fins	1			1
Doubler			1	1
Doubler strap			1	1
Doublers		1		1
Duct			1	1
Fairing (Dorsal Fin)	1			1
Fittings			1	1
Flap		1		1
Floorboards			1	1
Fuselage	1			1
Inboard flap		1		1
Left chine plate			1	1
Left hand chine plate			1	1
Longeron strap			1	1
Lower center wing		1		1
Main Landing Gear Pod			1	1
MLG Inspection Panel			1	1
Outboard truss mount		1		1
Overhead air duct			1	1
Panels		1		1
Pressure panel	1			1
Radome Beef-Up Straps			1	1
Reinforcement Plate			1	1
Rib			1	1
Rib assembly		1		1
Rib Cap		1		1
Rong segment			1	1
Rudder boost assembly	1			1
Slpoing longeron	1			1
Spar Cap		1		1
Strap			1	1

Table 3.46 C-130 AFMC-202, Records for the Top Part Description Noun Where the Damage Classification is "Corrosion" or "Crack" showing the Location Description Term and the Deficiency Description.

C130 202, Top Noun, Loc, corr & crack, Deficiency
29

Record	Noun	Location on Aircraft	Deficiency
63	Vertical Beam	Main Landing Gear	LH wheel well area, FS 577 vertical beam, WL 145, outboard upper hole has fatigue stress corrosion crack.
260	Vertical Beam	Main Landing Gear	Right FS 517 vertical beam has a crack.
64	Vertical Beam	Main Landing Gear	LH wheel well, FS 588 vertical beam, WL 145, inboard upper 3/4" hole has fatigue stress corrosion.
181	Vertical Beam	Main Landing Gear	NDI checks on lower FS 597 vertical beam, right side, reveals crack eminating from fastener hole 2nd from top of vertical beam repair outboard. Also, an additional crack located forward side of vertical surface behind repair location.
127	Vertical Beam	Main Landing Gear	Corrosion ground beyond limits on left vertical beam, FS 517, WL 150-154. Approximate grindout .100".
263	Vertical Beam	Main Landing Gear	Left FS 517 beam and bulkhead has extensive corrosion.
62	Vertical Beam	Main Landing Gear	LH wheel well, FS 588 vertical beam, WL 143, inboard lower 3/4" hole has fatigue stress corrosion.
817	Vertical beam	Main Landing Gear	Crack in right and left vertical beams, forward side.
61	Vertical Beam	Main Landing Gear	LH wheel well area, FS 577 vertical beam, WL 145, outboard upper hole has fatigue stress corrosion crack.
165	Vertical Beam	Main Landing Gear	Severe corrosion on right forward vertical beam, FS 517, WL 156, forward side at attach angle behind reinforcement plate.
279	Vertical Beam	Main Landing Gear	Severe corrosion on lower vertical beams & areas behind shelf brackets, left FS 517-528, 577-588.
37	Vertical Beam	Main Landing Gear	After removal of nonstandard repair from the left FS 517 vertical beam, severe corrosion was discovered throughout the area.
508	Vertical Beam	Mid-Fuselage	Corrosion and corrosion cracks on vertical beam at doubler matting area and crack on attack angle at forward beam, left lower wheel well, fuselage station 517.
832	Vertical Beam	Mid-Fuselage	Fuselage station 517 vertical beam inboard cap has severe corrosion and crack.
816	Vertical beam	Mid-Fuselage	Left forward vertical beam attach angle cracked.
620	Vertical beam	Mid-Fuselage	Corrosion has been ground out on 517 vertical beam and inboard cap in no grind area.
619	Vertical Beam	Mid-Fuselage	Vertical beam has had the corrosion ground-out in no grind area.. Fuselage staion 517 right.
617	Vertical Beam	Mid-Fuselage	Left vertical beam cap cracked in half at fuselage station 528 water line 210.
598	Vertical beam	Mid-Fuselage	Vertical beam, fuselage station 517 has cracked lower outboard edge. Request confirmation to repair according to 1C-130A-3.
409	Vertical Beam	Mid-Fuselage	Severe corrosion on upper end of vertical beam, FS 517, BL 61R, WL 280.
528	Vertical Beam	Mid-Fuselage	Left fuselage station 517 vertical beam cracked 6 inches in radius. Right fuselage station 517 3/4 bolt holes cracked.
380	Vertical Beam	Mid-Fuselage	Left FS 517 vertical beam has a crack in upper middle .5" bolt hole, WL 147. Crack is in radius on forward side FS 517, WL 147, and crack in attach angle forward side @ WL 168.
467	Vertical Beam	Mid-Fuselage	Removed corosion in no grind area (left vertical beam fuselage station 517 waterline 152).
444	Vertical Beam	Mid-Fuselage	Severe corrosion on left forward vertical beam.
435	Vertical Beam	Mid-Fuselage	Corrosion found on right 577 Vertical Beam in shelf bracket area.
428	Vertical Beam	Mid-Fuselage	Left & right vertical beam FS 517 has corrosion grind out exceeding limits on bottom area of aft side between forward face of shelf bracket mating surfaces & vertical beam.
419	Vertical Beam	Mid-Fuselage	There is approximately a 3" crack in aft radius of FS 517 vertical beam inner flange, left BL 61, WL 256.
381	Vertical Beam	Mid-Fuselage	Right FS 517 vertical beam has crack indication in lower outboard .75" bolt hole at WL 140. Crack in radius on forward side at WL 147. Also, a crack in the attach angle on the forward side of WL 168 exists.
537	Vertical Beam	Mid-Fuselage	Corrosion and corrosion cracks on vertical beam, radius and hole on vertical beam at doubler mating area and crack in attach angle forward side right lower wheelwell fuselage station 517.

3.4.3 C-130 Hercules - AIRS

Table 3.47 lists all the queries in the C-130 AIRS database (C130AIRS.mdb). The first group of AIRS queries is intended to identify general trends in the data concerning corrosion. Recall from Section 2.4 that AIRS archives only corrosion damage and repair records. First, the AIRS database is queried to separate the corrosion repair records into groupings by corrosion severity and type. Table 3.48 presents the AIRS data grouped by corrosion severity and a How-Malfunction (H/M) code. The AIRS database does not utilize H/M codes for each record but, one was added to facilitate queries using corrosion severity. Refer to Table 2.16 for a complete list of information available in the AIRS database. The H/M code definitions used here are the same as those used by the USAF in OACIS records. In AIRS, corrosion is recorded as mild/moderate (H/M=170) and severe (H/M=667). Of the 3769 total records, mild/moderate corrosion accounts for about 88%, severe corrosion accounts for about 10%, and a blank field accounts for the remaining 1%. Table 3.49 presents the AIRS records grouped by corrosion damage type (i.e. pitting, exfoliation, galvanic, etc.). Note that the list of damage types recorded in AIRS includes terms that do not describe corrosion (i.e. crack, unidentified, delaminated, dent, and a blank field). The reason for this is unknown. Of the 3769 total records, pitting accounts for about 88% and exfoliation accounts for about 9%. As sub groupings of the total AIRS records, mild pitting accounts for about 86% and severe exfoliation accounts for about 8%.

Next, two queries were performed that counted records grouped by model design series (MDS) and aircraft serial number. Table 3.50 presents the AIRS records grouped by MDS and Figure 3.49 presents the AIRS records grouped by aircraft serial number. The results from these queries assist in identifying a specific MDS or range of serial number which have higher than average record count values. With regard to MDS, the HC-130 accounts for about 35% of the 3769 total AIRS records. Note that there are 23 MDS entries, many of which are obvious variations of the same MDS. This lack of consistent MDS field entry should be avoided, but the trends presented here are still valid. With regard to the 116 aircraft serial numbers, the aircraft identified as 6905821 has about the twice the record count value of the serial number with the next highest

record count value. This one aircraft may be worth further investigation to determine the root cause for the high number of repairs for corrosion.

In order to identify and locate specific PSE with high record count values, several queries were performed that counted records grouped by part type (Part1) and aircraft zone location (Zone). Part1 is the record field in AIRS where a PSE key word is entered to describe the structural element being repaired. Table 3.49 presents the query results that counted records grouped by the AIRS part type nomenclature (Part1). If the record count values for "panel" and "plate" are combined as general skin elements then, skin PSEs account for 46% of the total records. Zone is the record field in AIRS where a location code is entered to describe the location of the repair. The Zone codes are not the same as the work area codes listed in Table 2.18. The definitions of the AIRS Zone codes was not obtained for this effort however, identifying the zones with high record count values is still valuable for more focused investigations. Table 3.52 presents the query results that counted records grouped by the AIRS zone location code (Zone). Note that zone 41 accounts for about 63% of the total records in AIRS while the zone with the next highest record count value (14) accounts for only 6%.

The next query counts records grouped by part type nomenclature (Part1) cross-tabbed by airframe zone location code (Zone) where the How-Malfunction codes are 170 or 667 (others not counted). The query results for the top ten Part1 terms from Table 3.51 and the top ten Zone codes from Table 3.52 are cross-tabbed and presented in Table 3.53 and Figure 3.50. As above, when the records for Part1 = panel are combined with the records for Part1 = plate and termed skins, then the skin PSEs in Zone 41 account for about 30% of total records.

The next few queries were performed to provide added detail to the part types and the locations. Figure 3.51 presents the query results that counted records grouped by part type (Part1) while cross-tabbed by the year the repair records was completed (Year). Figure 3.52 presents the query results that counted records grouped by the part type (Part1) and the How-Malfunction code. Figure 3.53 presents the query results that counted records grouped by fuselage station location (Loc) where the part type (Part1) is "panel". Table 3.54 presents the query results for the same type of query as was performed for Figure 3.53, but only record counts greater than 17 are listed where Part1

= “panel”. These are the fuselage locations of the panels that have experienced higher than average numbers of repairs for corrosion. Figure 3.54 presents the query results that counted records grouped by fuselage station location (Loc) where the part type (Part1) is “longeron”. The fuselage station where longerons are experiencing the most frequent repairs for corrosion is FS 757. This trend was expected since anecdotal information from the C-130 ALC has identified the C-130 sloping longeron (FS 757 to FS 1041) as suffering from frequent repairs for corrosion.

In general, the AIRS database identifies mild corrosion as the dominant corrosion severity while OACIS identifies severe corrosion as the dominant group. This was expected considering the source of the data for these two databases. The trends from the AIRS database agrees with the trends indicated by OACIS and AFMC-202 in identifying panels and planks (skins) as the PSE group experiencing the most repairs for corrosion. The airframe zones location codes (Zone) were also identified for all PSE types (Part1) discussed above while the fuselage station locations (Loc) were identified for panels and longerons. The fuselage station locations could also be identified for all PSE types (Part1) in AIRS.

Table 3.47 List of Queries contained in the C-130 AIRS Access Database (C130Airs.mdb)

Name of Queries in C130Airs.mdb
C130 AIRS, Corrosion Severity, Ct Rec.
C130 AIRS, Damage Type, 667&170, Ct Rec.
C130 AIRS, Loc, Part1=Longeron, 667&170, Ct Rec.
C130 AIRS, Loc, Part1=Panel, 667&170, Ct Rec.
C130 AIRS, Loc, Part1=Panel, Zone41, 667&170, Ct Rec.
C130 AIRS, MDS, 667&170, Ct Rec.
C130 AIRS, MDS, Zone41, 667&170, Ct Rec.
C130 AIRS, Part1, 667&170, Ct Rec.
C130 AIRS, Part1, year, 667&170, Ct Rec.
C130 AIRS, Part1, Zone, 667&170, Ct Rec.
C130 AIRS, Part1, Zone41, 667&170, Ct Rec.
C130 AIRS, SER#, 667&170, Ct Rec.
C130 AIRS, Zone, 667&170, Ct Rec.
C130 AIRS, Zone, year, 667&170, Ct Rec.

Table 3.48 C-130 AIRS, Count Records Grouped by Corrosion Severity Linked to How-Malfunction Code.

C130 AIRS, Corrosion Severity, Ct Rec

Sum = 3769

Corrosion Severity	H/M Code	CountOfRecord
MILD/MOD	170	3332
SEVERE	667	390
		47

Table 3.49 C-130 AIRS, Count Records Grouped by Damage Type Where the How Malfunction Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or Other.

C130 AIRS, Damage Type, 667&170, Ct Rec

	H/M Code Count of Records			
Sum =	3332	390	47	3769
Average =	666	78	16	
Type of Damage	**170**	**667**	**<>**	**sum**
PITTING	3253	61		3314
EXFOL.	12	311		323
GALVANIC	62	12		74
	1		26	27
CRACK			19	19
UNIF.ETC	4	2		6
DELAMIN		4		4
DENT			2	2

Table 3.50 C-130 AIRS, Count Records Grouped by Model Design Series (MDS) Where the How Malfunction Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or Other.

C130 AIRS, MDS, 667&170, Ct Rec

Sum =	3332	390	47	3769
Average =	145	28	12	
	H/M Code			
	Count of Records			
MDS	170	667	<>	sum
HC-130	1152	156		1308
C-130E	445	65	26	536
AC-130	421	34		455
WC-130	225	26		251
C130E	201	22		223
AC130A	160	13		173
EC-130	123	11		134
HC130P	99	18		117
C-130B	111	4		115
C130B	106	7		113
MC-130	74	7		81
EC130E	62	6		68
C130H	47	18		65
C-130H	43		2	45
C-130	22			22
AC130H	19			19
-C130E	2		14	16
AC130E	7	3		10
LC-130	8			8
-C130H	1		5	6
WC130H	2			2
-C130B	1			1
C130A	1			1

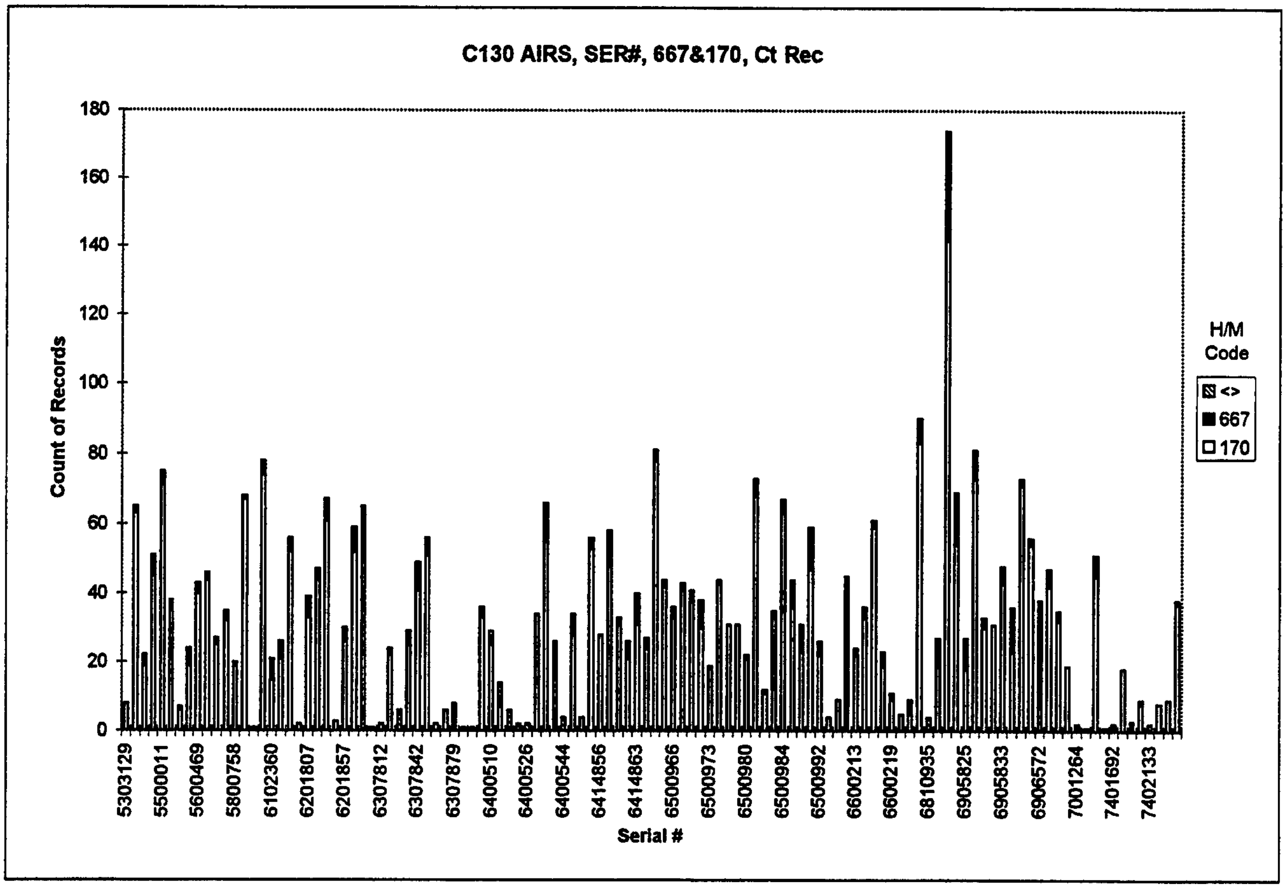


Figure 3.49 C-130 AIRS, Count Records Grouped by Aircraft Serial Number Where the How Malfunction Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or Other.

Table 3.51 C-130 AIRS, Count Records Grouped by Part Type Nomenclature (Part1) Where the How Malfunction Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or Other.

C130 AIRS, Part1, 667&170, Ct Rec

Sum = 3332 390 47 3769

H/M Code

Count of Records

Part 1	170	667	<>	sum
PANEL	1398	86	2	1486
FITTING	288	47		335
ANGLE	266	56		322
LONGERON	240	62		302
OTHER	236	28	39	303
FRAME	227	15		242
PLATE	220	32		252
DOOR	146	9		155
WEB	124	18	2	144
DOUBLER	81	14	2	97
BEAM/SPAR	30	10		40
BRACE	18		2	20
RIB CAP	12	1		13
BEAM CAP	8	2		10
TUBE	7			7
RING	5	7		12
BEAM TIE	5	2		7
STRINGER	5			5
STIFFENER	3	1		4
	3			3
SPONSON	2			2
CHANNEL	1			1
CLIP	1			1
CYLINDER	1			1
DECK	1			1
LINK	1			1
ROD	1			1
TRUSS	1			1
INTERCOST	1			1

Table 3.52 C-130 AIRS, Count Records Grouped by Zone Location Nomenclature (Zone) Where the How Malfunction Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or Other.

C130 AIRS, Zone, 667&170, Ct Rec

Sum = 3332 390 47 3769

H/M Code

Count of Records

Zone	170	667	<>	sum
41	2075	283	26	2384
14	214	14		228
11	150	12		162
33	126	9		135
42	123	12		135
32	100	5		105
71	85	4	14	103
31	79	5	1	85
13	51	4	2	57
51	50	6		56
81	41	2		43
53	35			35
61	34	9		43
44	31	15	4	50
34	25	2		27
12	18			18
82	15	2		17
35	11			11
54	11			11
45	10	5		15
62	9	1		10
66	9			9
55	8			8
63	5			5
15	5			5
36	3			3
43	3			3
57	2			2
64	2			2
56	1			1
65	1			1

Table 3.53 C-130 AIRS, Count Records Grouped by Part Type Nomenclature (Part1) Cross-Tabbed with Zone Location Nomenclature (Zone) Where the How Malfunction Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or Other (Only the top ten Part1 and Zone types are counted and shown here).

C130 AIRS, Part1, Zone, 667&170, Ct Rec

Sum = 2290 226 152 134 127 99 84 81 42 53 3288

Zone

Count of Records

Part 1	41	14	11	33	42	32	71	31	51	13	Sum
PANEL	766	125	38	104	69	88	36	34	33	42	1335
FITTING	261		17	3			6	24			311
ANGLE	245		3	4	24	2	10	2		2	292
LONGERON	302										302
OTHER	153	4	8	6	9	8	18	2	6	7	221
PLATE	233					1		2	1		237
FRAME	133	47	30	2	5		3	9	1		230
DOOR	44	45	16	15	15		11	3			149
WEB	62	5	37		5			4	1	2	116
DOUBLER	91		3					1			95

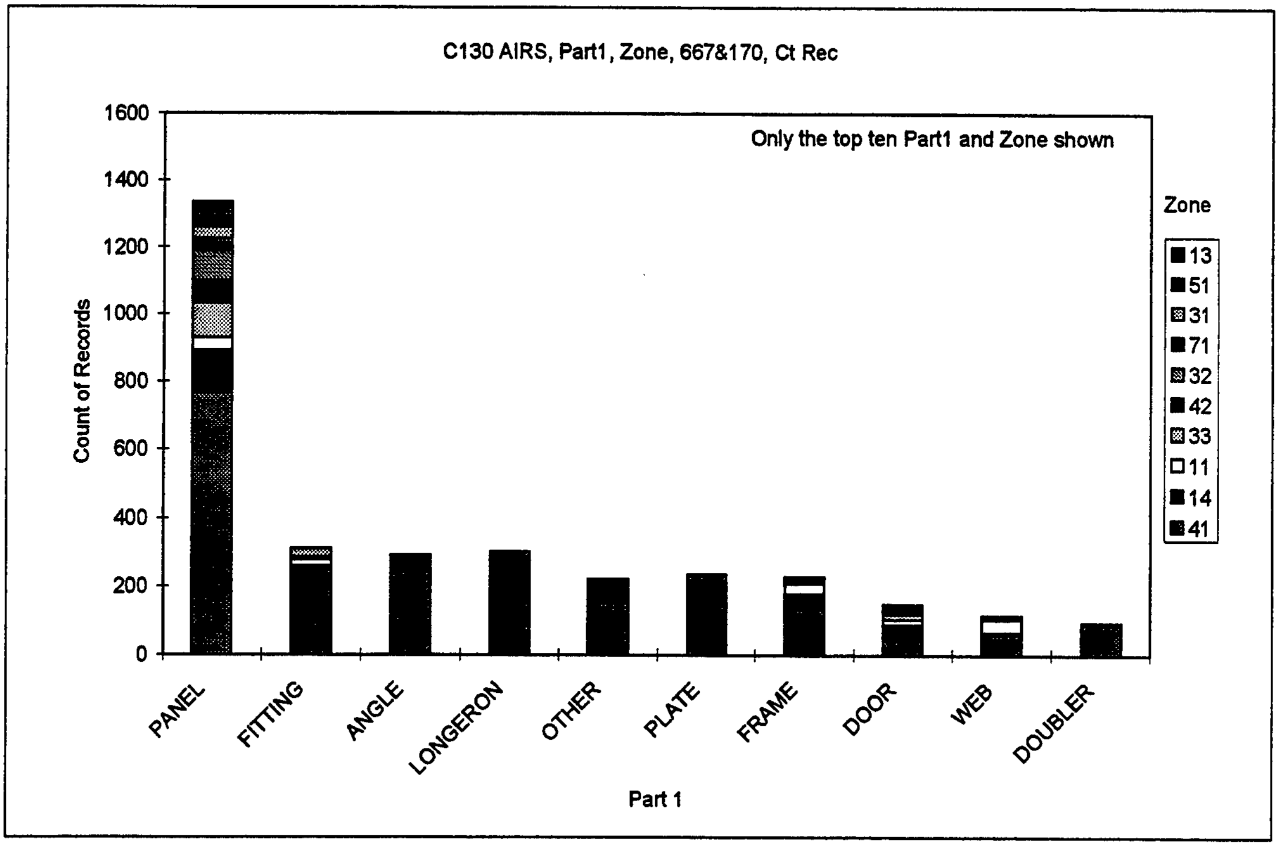


Figure 3.50 C-130 AIRS, Count Records by Part Type Nomenclature (Part1) Cross-Tabbed with Zone Location Nomenclature (Zone) Where How Malfunction Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or Other (Only the top ten Part1 and Zone types are counted and shown here).

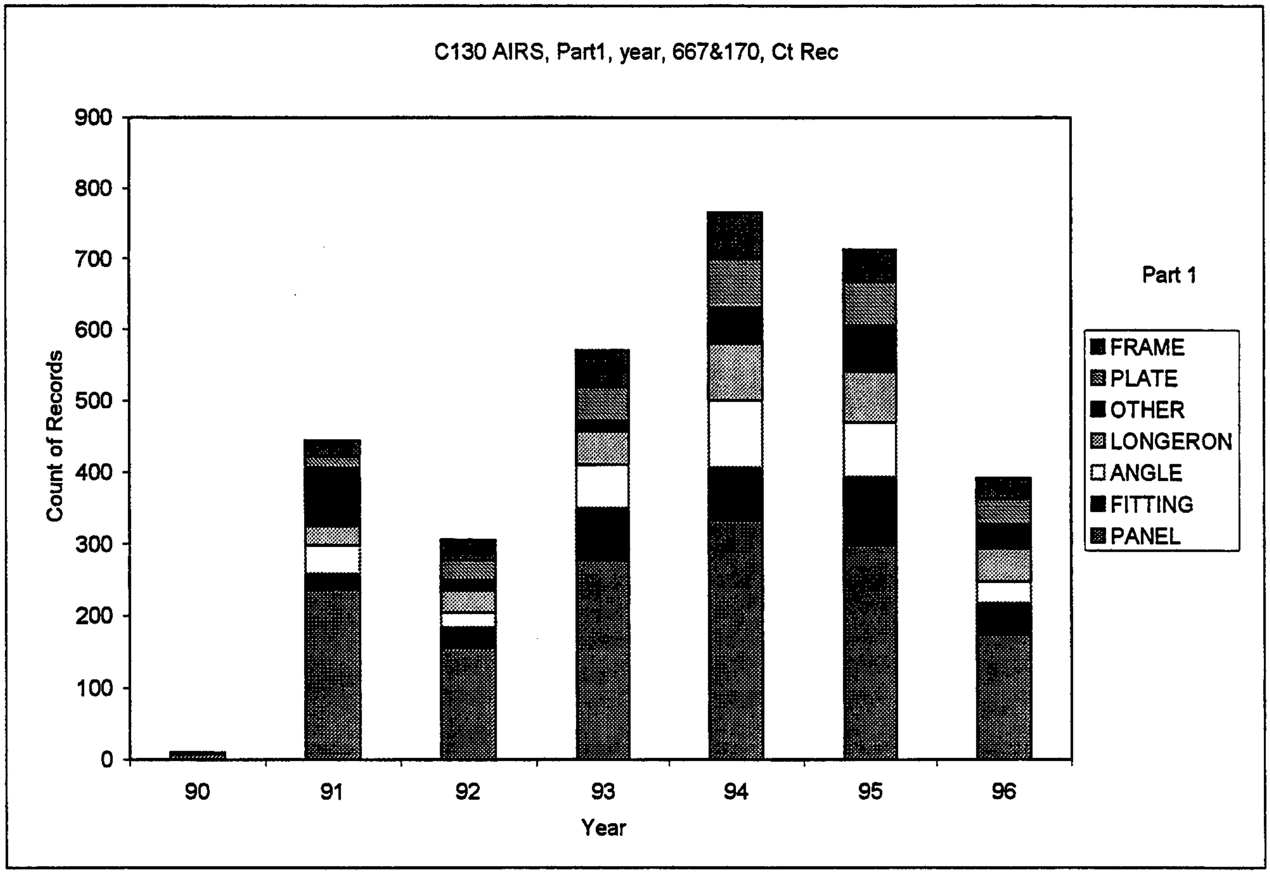


Figure 3.51 C-130 AIRS, Count Records Grouped by Part Type Nomenclature (Part1) Cross-Tabbed with Year the Repair Record Completed (Year) Where the How Malfunction Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or Other (Only the top seven Part1 types are shown here).

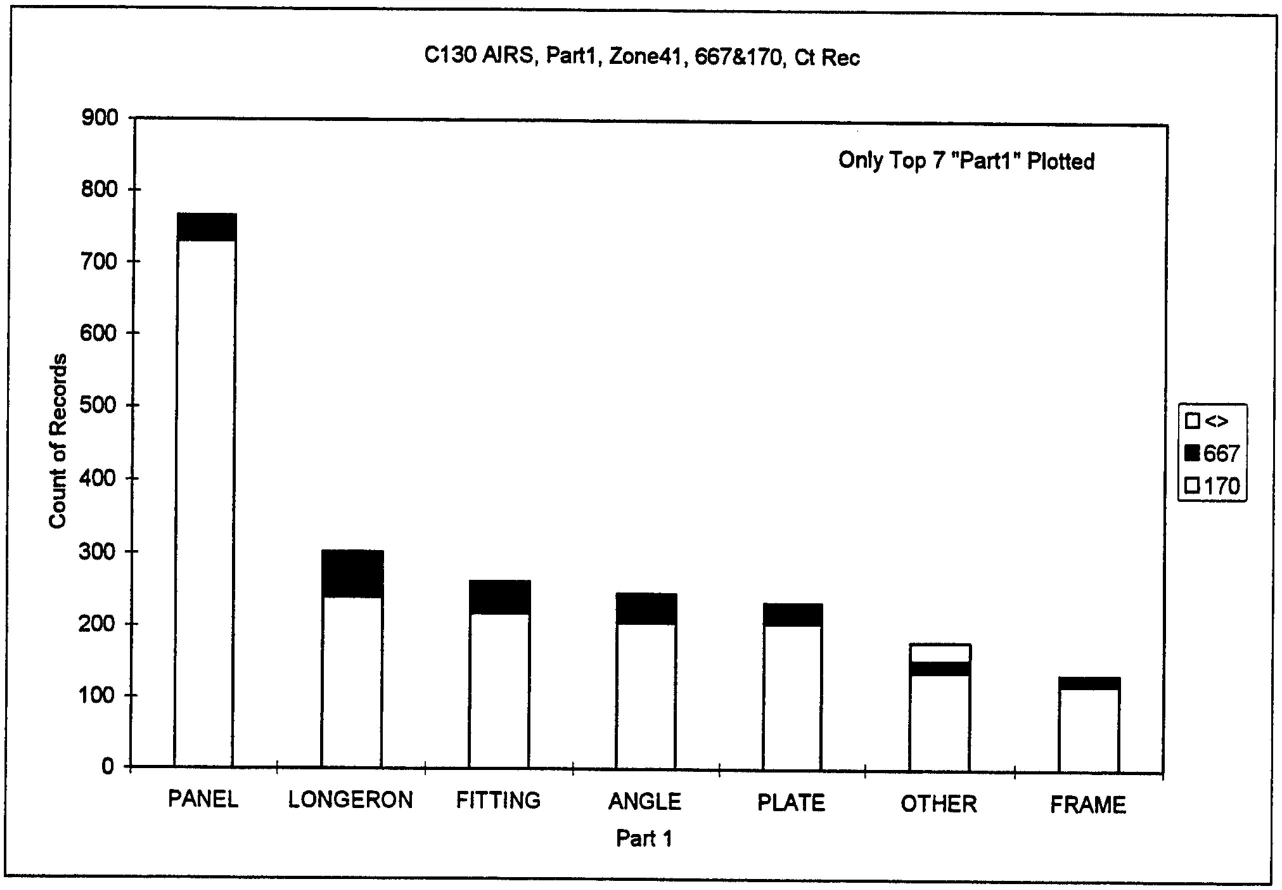


Figure 3.52 C-130 AIRS, Count Records Grouped by Part Type Nomenclature (Part1) Where the How Malfunction Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or Other (Only the top seven Part1 types are shown here).

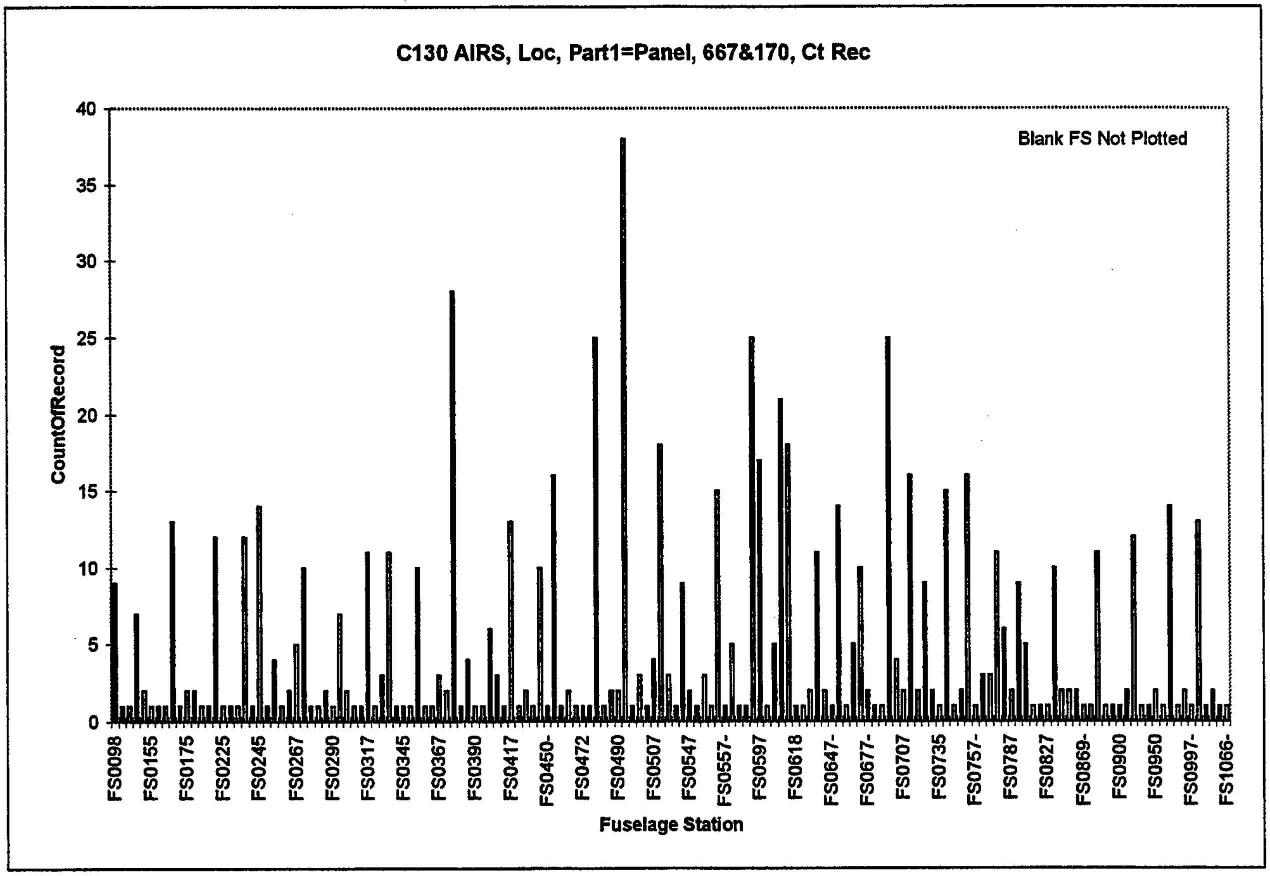


Figure 3.53 C-130 AIRS, Count Records Grouped by Fuselage Station Location (Loc) Where the Part Type Nomenclature (Part1) is "Panel" and Where the How Malfunction Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or Other.

Table 3.54 C-130 AIRS, Count Records >17 Grouped by Fuselage Station Location (Loc) Where the Part Type Nomenclature (Part1) is "Panel", the Zone Location Nomenclature (Zone) is "41", and the How Malfunction Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or Other.

C130 AIRS, Loc, Part1=Panel, Zone 41, 667&170, Ct Rec > 17

Sum = 198

	Zone 41
Fuselage Station	CountOfRecord
FS0497	38
FS0377	28
FS0477	25
FS0577	25
FS0697	25
FS0607	21
FS0517	18
FS0617	18

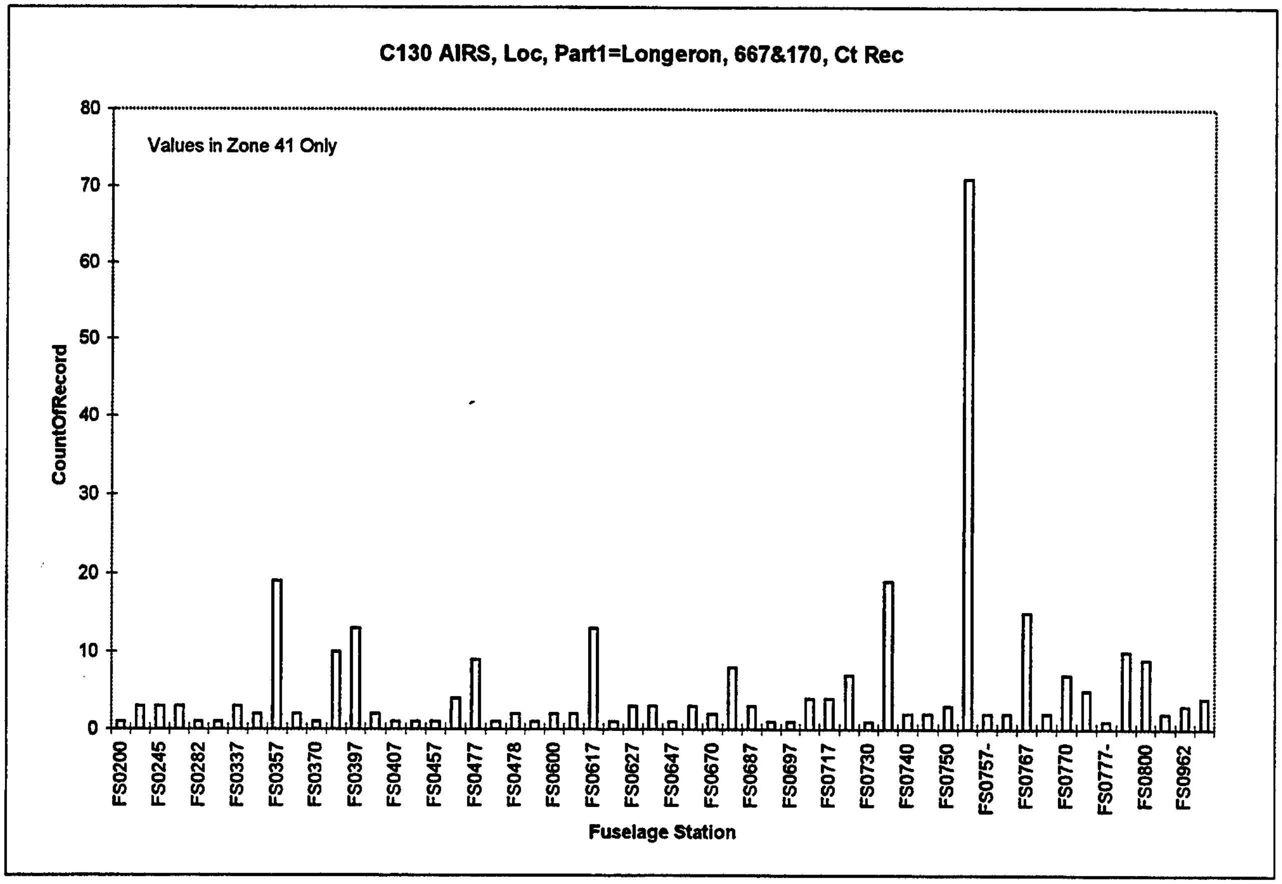


Figure 3.54 C-130 AIRS, Count Records Grouped by Fuselage Station Location (Loc) Where the Part Type Nomenclature (Part1) is "Longeron", the Zone Location Nomenclature (Zone) is "41", and the How Malfunction Code is 667 (Severe Corrosion), 170 (Mild/Moderate Corrosion), or Other.

3.4.4 C-130 Hercules - REMIS

Table 3.55 lists all the queries in the C-130 REMIS database (C130REMIS.mdb). The first group of REMIS queries is intended to identify some general trends in the data concerning corrosion. Recall from section 2.4 that REMIS archives only corrosion damage and repair records. REMIS does not archive any information describing the type or degree of corrosion but does include the number of corrosion occurrences. Refer to Table 2.17 to identify all the information available in the REMIS database.

Two queries of the REMIS database were performed to count records grouped by aircraft serial number. These results assist in identifying specific aircraft or groups of aircraft that have higher than average record count values. First, Figure 3.55 presents query results that counted all REMIS records grouped by aircraft serial number. In REMIS, there are a total of 2922 total records for 447 aircraft serial numbers (average is 6.5 records per serial number). Note that there are two groups of consecutive aircraft serial numbers that exceed a record count value of about 20. These two groups are the eight aircraft with serial numbers 8800004401 through 8800004408 and the six aircraft with serial numbers 8900009101 through 8900009106. Second, Figure 3.56 presents the query results that counted records grouped by aircraft serial number where the work unit codes (WUC) have an associated DADTA point. This query identifies 176 records for 64 aircraft serial numbers or that only 6% of the total REMIS records describe corrosion on DADTA points.

The work unit code (WUC) identifies a specific set of work instructions performed for specific components and locations. Thus, the description of selected WUCs can be obtained and used to identify parts and their location. Table 3.56 presents the query results that counted records and summed the Corrosion Occurrences grouped by WUC. Table 3.57 presents the query results that counted records and summed Corrosion Occurrences grouped by WUC with an associated DADTA point. These top few WUCs could be further defined to identify the parts and their locations.

Next, several queries were performed to identify some specific PSEs and locations experiencing higher than average occurrences of corrosions. Table 3.58 presents the query results that counted records grouped by WUCs with associated

DADTA points listing the Major Section location terms and the Section descriptions. Of the 176 records, 74 are associated with skin panels on the wings. Table 3.59 presents the query results that counted records grouped by applicable DADTA points linked to the WUC and cross-tabbed with the Major Section location terms. The results from this query yield a similar ranking compared to that reported by ARINC in Reference [21] plus it provides the record count values to justify the ranking. Table 3.60 presents the query results that counted records where the WUC has an applicable DADTA point grouped by the Section description and cross-tabbed with the Major Section terms.

Finally, Figure 3.57 presents the query results that counted records and averaged the Mean Time Between Corrosion occurrence (MTBC) values grouped by the associated DADTA point linked to the WUC. This figure identifies those DADTA points experiencing a relatively low number of flight hours between corrosion repair actions. These are the points that should be further evaluated for corrosion resistances or possible reduction of residual strength. The three DADTA points with the lowest MTBC averages are on the center wing.

In general, the identification of wing skins as the DADTA points with highest record counts agrees with the OACIS results. In using REMIS, the description of the WUCs are needed to better estimate the extent of corrosion on the general PSEs and their locations.

Table 3.55 List of Queries Contained in the C-130 REMIS Access Database (C130REMIS.mdb).

Name of Queries in C130REMIS.mdb
C130 REMIS, GeoLoc, Count Records
C130 REMIS, GeoLoc, MDS, Count Records
C130 REMIS, Records w/DADTA, GeoLoc, Count Records
C130 REMIS, Records w/DADTA, GeoLoc, MDS, Count Records
C130 REMIS, Records w/DADTA, Maj Sect, Count Records
C130 REMIS, Records w/DADTA, Maj Sect, Sect, Ct Rec.
C130 REMIS, Records w/DADTA, Maj Section, Avg MTBF, Ct Rec.
C130 REMIS, Records w/DADTA, SER#, GeoLoc, MDS, Count Records
C130 REMIS, Records w/DADTA, SER#, MDS, Count Records
C130 REMIS, SER#, GeoLoc, Count Records
C130 REMIS, SER#, GeoLoc, Count Records x
C130 REMIS, SER#, GeoLoc, MDS, Count Records
C130 REMIS, SER#, MDS, Count Records
C130 REMIS, SER#, Top 6 GeoLoc, Count Records
C130 REMIS, WUC w/DADTA, Maj Sect, Sect, Ct Rec.
C130 REMIS, WUC w/DADTA, Sum Corr Occurrences, Count Records
C130 REMIS, WUC, Sum Corr Occurrences, Count Records

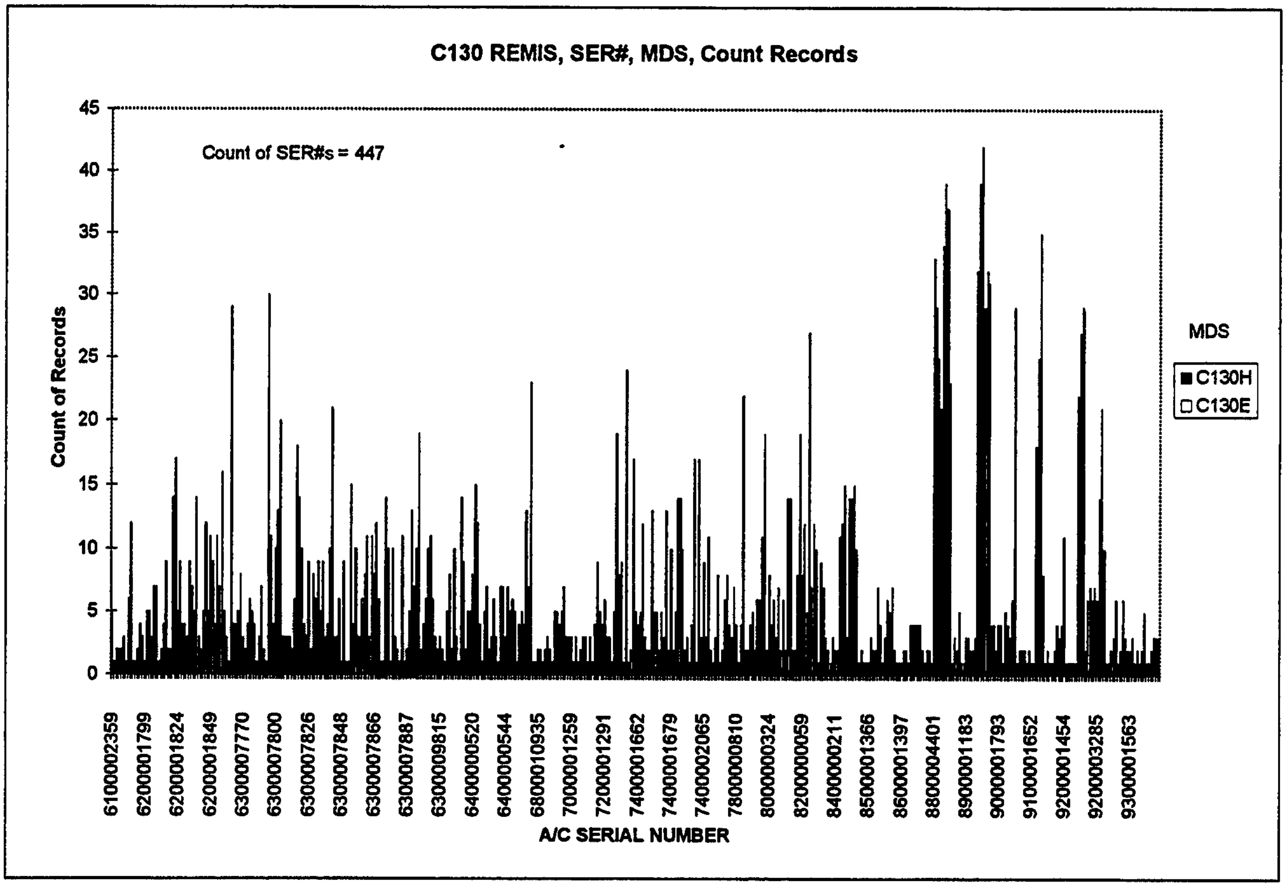


Figure 3.55 C-130 REMIS, Count Records Grouped by Aircraft Serial Number (SER#) Cross-Tabbed by Model Design Series (MDS).

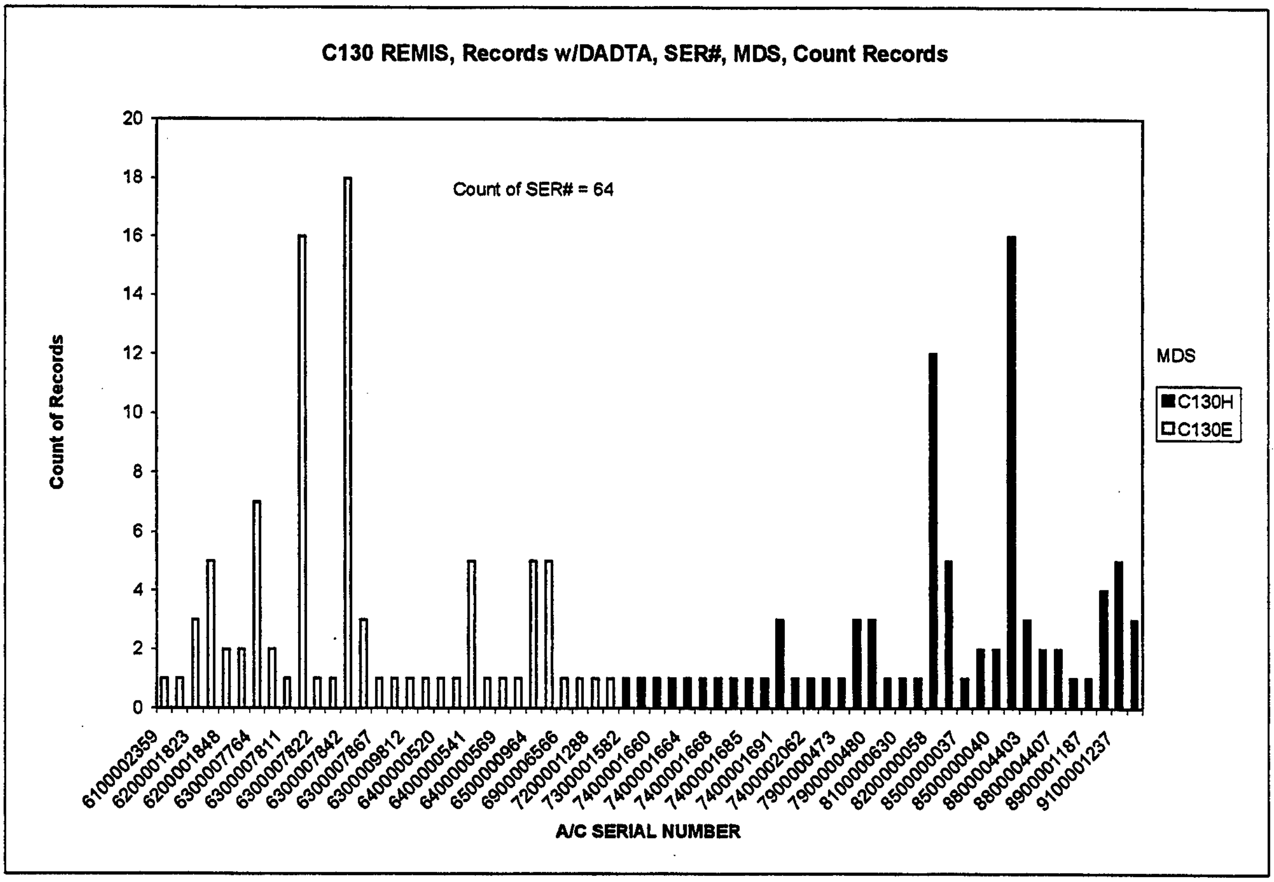


Figure 3.56 C-130 REMIS, Count Records Grouped by Aircraft Serial Number where the WUC has an Associated DADTA Point and Cross-Tabbed by Model Design Series (MDS).

Table 3.56 C-130 REMIS, Count Records and Sum Corrosion Occurrences Grouped by Work Unit Code (WUC).

C130 REMIS, WUC, Ct Rec, Sum Corr Occurances

Sum	2922	5045

WORK UNIT CODE	CountOfRecord	SumOfCORROSION OCCURENCES
11000	245	1007
11500	69	179
11540	36	81
1143C	42	77
11400	47	72
11412	26	69
11299	27	69
11499	40	68
1151V	32	65
1143G	20	61
11431	36	60
1154P	11	58
11310	29	52
11610	37	48
11240	39	48
11321	30	45
1142W	35	44
11280	30	44
11120	32	43
11541	20	42
11270	26	42
11512	25	41
1154Y	20	41
11435	16	41
11420	31	41
11520	25	40
1112G	20	40
11425	14	40
479 other WUC's	1862	2487

Table 3.57 C-130 REMIS, Count Records and Sum Corrosion Occurrences Grouped by Work Unit Code (WUC) with an Associated DADTA Point.

C130 REMIS, WUC w/DADTA, Ct Rec, Sum Corr Occurances

Sum 176

Ratio

WORK UNIT CODE	CountOfRecord	SumOfCORROSION OCCURENCES
114GA	25	32
11570	32	32
114G0	25	25
115C0	12	18
11560	18	18
1151S	12	12
11XJA	4	8
114FB	7	7
1157C	2	6
1152M	5	5
1152A	5	5
1157D	1	3
11XLM	3	3
114FF	2	2
114AB	2	2
114FD	2	2
115B0	2	2
11WBL	2	2
11WDE	2	2
11WDG	2	2
11XCR	2	2
11YLQ	1	1
115CA	1	1
11WBA	1	1
11WBF	1	1
1151T	1	1
11WEG	1	1
11XJJ	1	1
11YJJ	1	1
115BA	1	1

Table 3.58 C-130 REMIS, Count Records Grouped by the Work Unit Code (WUC) with an Associated DADTA Point, the Major Section, and the Section.

C130 REMIS, WUC w/DADTA, Maj Sect, Sect, Ct Rec

Sum 176

WORK UNIT CODE	Major Section	Section	CountOfRecord
11570	Center Wing	Panel	32
114G0	Fuselage	Aft	25
114GA	Fuselage	Aft	25
11560	Outer Wing	Panel	18
1151S	Outer Wing		12
115C0	Center Wing	Beam Assy	12
114FB	Fuselage	Cargo	7
1152A	Center Wing		5
1152M	Center Wing		5
11XJA	Outer Wing	Skin, Panel 4, LHS	4
11XLM	Outer Wing	Skin, Panel 2, LHS	3
114AB	Fuselage	Cargo	2
114FD	Fuselage	Cargo	2
114FF	Fuselage	Cargo	2
1157C	Center Wing	Panel	2
115B0	Outer Wing	Beam Assy	2
11WBL	Center Wing	Skin, Panel 1	2
11WDE	Center Wing	Skin, Panel 3	2
11WDG	Center Wing	Skin, Panel 3	2
11XCR	Outer Wing	Skin, Panel 2, LHS	2
1151T	Outer Wing		1
1157D	Center Wing	Panel	1
115BA	Outer Wing	Beam Assy	1
115CA	Center Wing	Beam Assy	1
11WBA	Center Wing	Skin, Panel 1	1
11WBF	Center Wing	Skin, Panel 1	1
11WEG	Center Wing	Skin, Panel 4	1
11XJJ	Outer Wing	Skin, Panel 4, LHS	1
11YJJ	Outer Wing	Skin, Panel 4, RHS	1
11YLQ	Outer Wing	Skin, Panel 2, RHS	1

Table 3.59 C-130 REMIS, Count Records Grouped by Applicable DADTA Point linked to the WUC Cross-Tabbed by the Major Section.

C130 REMIS, Records w/DADTA, Maj Sect, Count Records

Sum	67	63	46	176

Applicable DADTA Point	Center Wing	Fuselage	Outer Wing	Sum
AF-4B		30		30
CF-3		13		13
AF-10		7		7
CF-4		7		7
CF-1		6		6
CW-21B	5			5
CW-21E	5			5
CW-22A	5			5
CW-10	4			4
CW-12	4			4
CW-19	4			4
CW-35	4			4
CW-24	3			3
OW-16			3	3
OW-18			3	3
OW-19			3	3
OW-25			3	3
OW-45	1		2	3
CW-1	2			2
CW-20	2			2
CW-23	2			2
CW-3A	2			2
CW-4	2			2
CW-5C	2			2
CW-5J	2			2
CW-6	2			2
CW-7B	2			2
CW-8	2			2
CW-9	2			2
OW-26B			2	2
OW-35			2	2
OW-5H			2	2
OW-7A			2	2
OW-7D			2	2
OW-8A			2	2
Other DADTA Pts each =1	10	0	20	30

Table 3.60 C-130 REMIS, Count Records where the WUC has an Applicable DADTA Point Grouped by the Section and Cross-Tabbed by the Major Section.

C130 REMIS, Records w/DADTA, Maj Sect, Sect, Ct Rec

Sum	67	63	46	176

Section	Center Wing	Fuselage	Outer Wing	Sum
Panel	35		18	53
Aft		50		50
	10		13	23
Beam Assy	13		3	16
Cargo		13		13
Skin, Panel 2, LHS			5	5
Skin, Panel 4, LHS			5	5
Skin, Panel 1	4			4
Skin, Panel 3	4			4
Skin, Panel 2, RHS			1	1
Skin, Panel 4	1			1
Skin, Panel 4, RHS			1	1

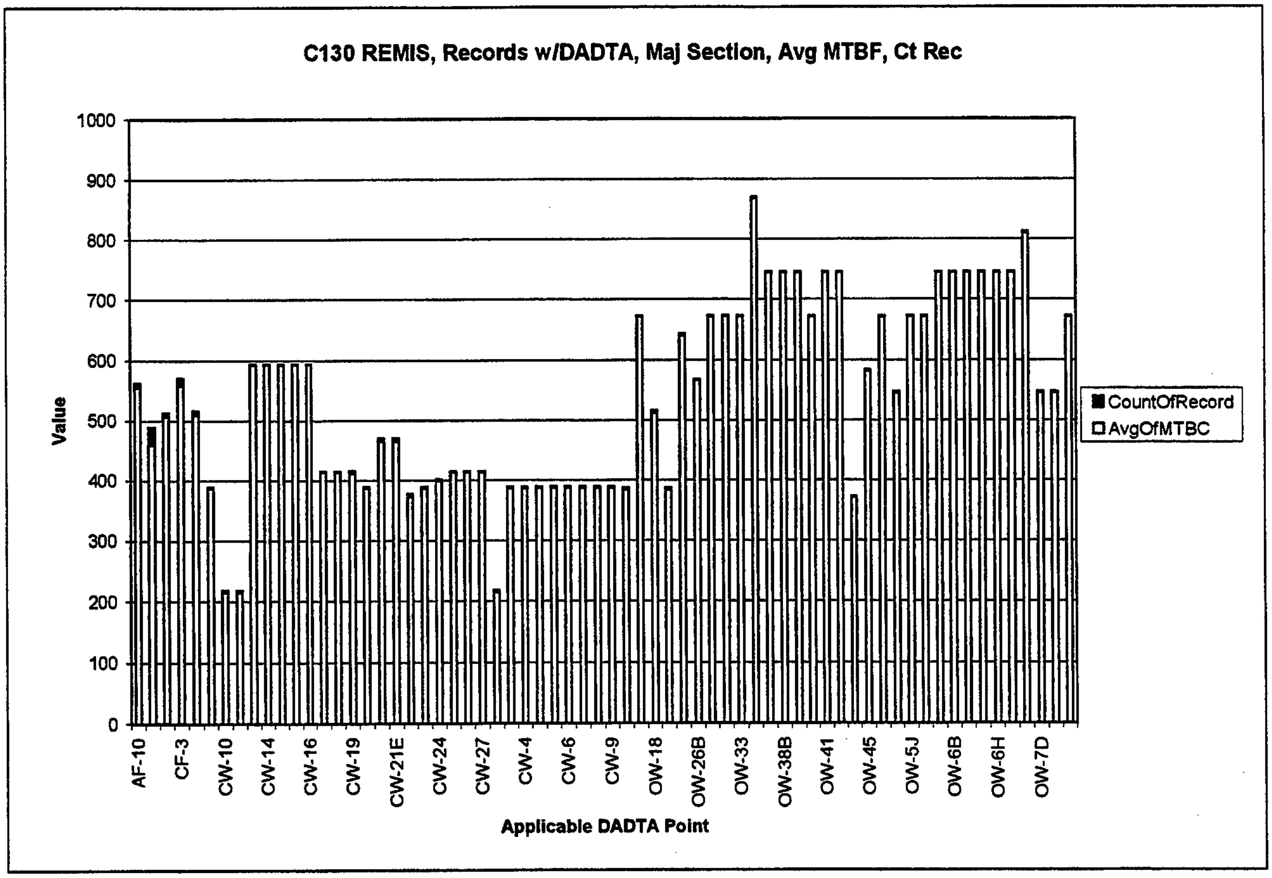


Figure 3.57 C-130 REMIS, Count Records and Average the Mean Time Between Corrosion Occurrence Values Grouped by the Applicable DADTA Point linked to the WUC.

3.5 C-5A/B Galaxy

One database was used to estimate the extent of corrosion and cracking for the C-5A/B fleet of aircraft. For the C-5 fleet, inspection and repair data were available from the SA-ALC where a sustaining effort by the ALC/LADE group developed and populated the database. The C5-ALC database contains records of structural repairs, which required an engineering disposition. A primary intent of the LADE engineers in developing and maintaining the database was to facilitate repeated and similar repairs. The C5-ALC database was queried to generate information covering the entire fleet. The following discusses the database queries and the results they indicate. The results are estimates of which principal structural elements (PSEs) are being found with corrosion and fatigue cracking damage.

3.5 C-5A/B Galaxy – SA-ALC

Table 3.61 lists all the queries in the C5-ALC database (C5ALC.mdb). The contents of the C5ALC database are defined in Table 2.16. First, some queries were performed to assemble general information about the contents of the database. Of the 4302 total records in the C5ALC database, 3713 repair records are attributed to 123 aircraft serial numbers and 589 records are attributed to the back-shops. The 4302 records are for a full range of engineering disposition repairs. Blank fields are a potential problem for queries using part number (P/N), fuselage station (FS), and aircraft area location (Area). Of the 4302 total records in the C5ALC database, 87% of FSs are blank, 53% of the P/Ns are blank, and 31% of the Area cells are blank. As a result, P/N and FS were not used in any of the queries. But, Area is still considered viable for developing trends since two thirds of the entries are available.

First, the C5ALL table within the C5ALC database was queried to identify the records attributed to corrosion and cracking damage. This was achieved by creating a sub database table (C5ALL*) of only records associated with corrosion or cracking damage in the Discrepancy text field. In addition, a Damage Code field was added to identify the cause of the corrosion (CN) or cracking (CK) damage. All the following queries discussed in this section were performed with the C5ALL* table within the

C5ALC database. The query results generated from C5ALL* were verified against the records in the original C5ALL database table.

Figure 3.58 presents the query results that counted records grouped by the aircraft serial number (SER_No). The first two digits in the serial number indicate the year the aircraft was delivered to the USAF (usually the same year the aircraft was manufactured). Note that the average number of records for aircraft delivered prior to 1970 is about twice as high as the average for the newer aircraft. The aircraft delivered prior to 1970 are the C-5A model and those delivered after 1970 are the C-5B models. Figure 3.59 presents the query results that counted records grouped by the aircraft area location term (Area) where the damage code is corrosion (CN) or crack (CK). Other than blank fields, the Area terms with the top three record count values are inside fuselage, empennage, and outside fuselage. Note that repair records attributed to cracking damage out number corrosion damage records by a factor of 3. Looking at corrosion versus cracking for each Area, note that only the empennage has more records attributed to corrosion than cracking. A query of the empennage corrosion records indicates that 72 of the 84 corrosion records are located on the horizontal stabilizer.

In order to identify and locate specific PSEs with higher than average record count values, several queries were performed on the corrosion and cracking records (C5ALL*). Each query counts records with the occurrence of a select PSE key word that was included in the Area field describing the location of the damage or the Discrepancy field describing the damage. The summary results from these queries are presented in Table 3.62. Note that "frames" and 'beams" are the PSEs with the highest record count values and that cracking damage account for 96% of these records. In order to identify the locations of the PSEs listed in Table 3.62, some of the individual queries counting records grouped Area for each PSE key word are presented in Tables 3.63 through 3.67. Note that for "'beams" and "frames" listed in Tables 3.63 and 3.64, the majority of cracking damage is located on the inside fuselage followed by the landing gear. As stated above for the empennage, Table 3.65 identifies the 72 records attributed to corrosion damage on the stabilizer. Table 3.66 and 3.67 lists the location of the "skin" and "panel" corrosion and cracking damage. The records counted by PSE key word in

the above trends account for about 60% of the total 1178 records identified with corrosion or cracking damage.

In general, beam and frame cracking on the fuselage has been identified as the largest group of records. The horizontal stabilizer was identified as the PSE with the highest number of repairs due to corrosion damage.

Table 3.61 List of Queries Contained in the C-5 Access Database (C5ALC.mdb).

Name of Queries in C5ALC.mbd
C5 All*, Area, Code, count records
C5 All*, Area, Code, Descrip like *?*, count records
C5 All*, SER#, Code, count records
C5 All, Area, Closed year, count Records
C5 All, Area, Descrip like *corr*, count records
C5 All, Area, Descrip like *crack*, count records
C5 All, Area, Record, Descrip like *corr* & *?*
C5 All, Area, Record, Descrip like *crack* & *?*
C5 All, Descrip like *corr* & *stab*, Area *emp*
C5 All, Descrip like *corr*, Area like *?*
C5 All, Descrip like *corr*, Area like *emp*
C5 All, Descrip like *corr*, Area like *fuse*
C5 All, Descrip like *corr*, Area like *gear*
C5 All, Descrip like *corr*, Area like *pylon*
C5 All, Descrip like *corr*, Area like *wing*
C5 All, Descrip like *crack*, Area like *?*
C5 All, Descrip like *crack*, Area like *emp*
C5 All, Descrip like *crack*, Area like *fuse*
C5 All, Descrip like *crack*, Area like *gear*
C5 All, Descrip like *crack*, Area like *pylon*
C5 All, Descrip like *crack*, Area like *wing*
C5 All, Record, SER#, Descrip, Area, Code CN or CK = All*
C5 All, SER No, Descrip like *corr*, count records
C5 All, SER No, Descrip like *crack*, count records
C5 All, SER#, Closed year, count Records
Note:
fuse = fuse or ramp or cargo or door or latrine or cockpit or crew
emp = emp
wing = wing or aileron or flap
gear = nlg or mlg
pylon = pylon or engine

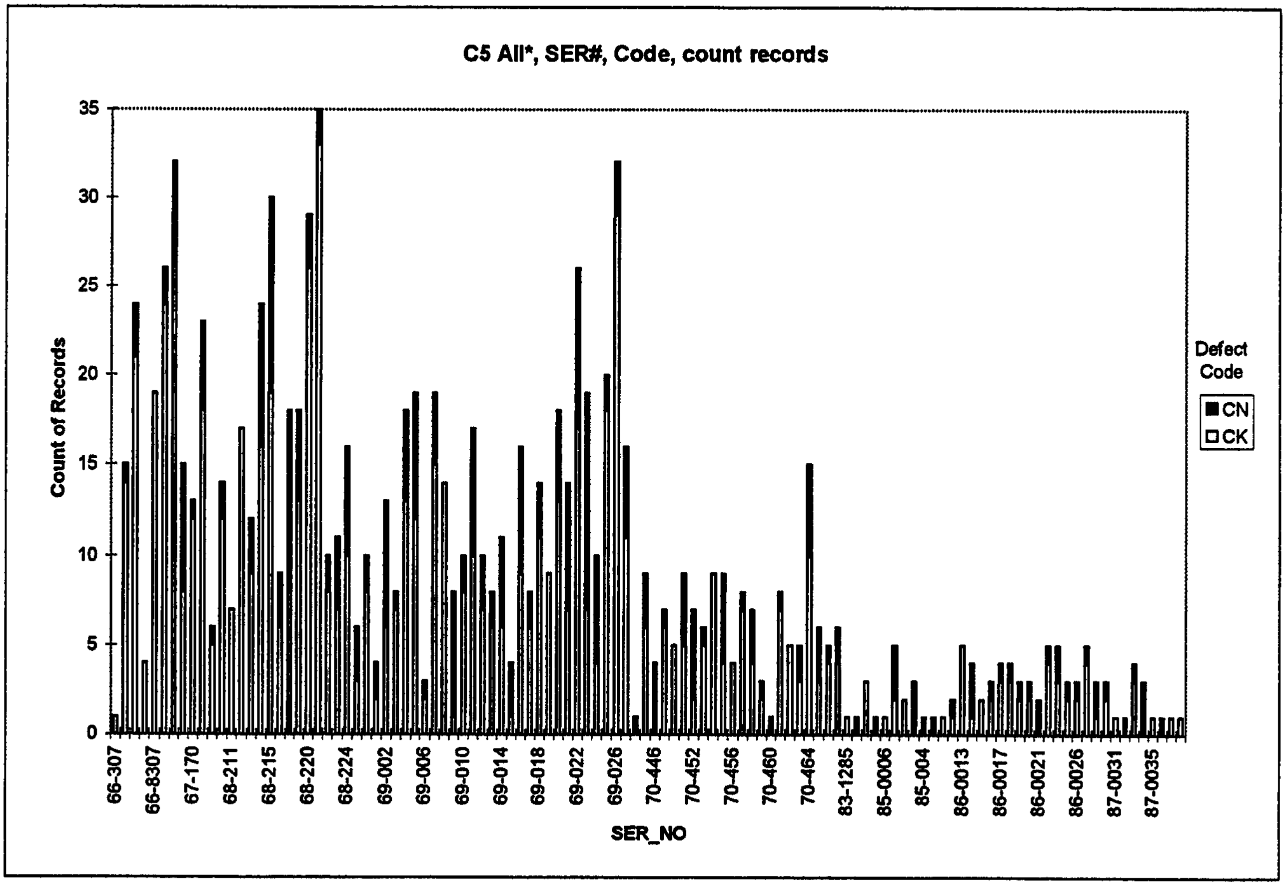


Figure 3.58 C5 ALC All, Count Records grouped by Aircraft Serial Number (SER_No) where the Discrepancy Descriptions included Corrosion (CN) or Crack (CK).

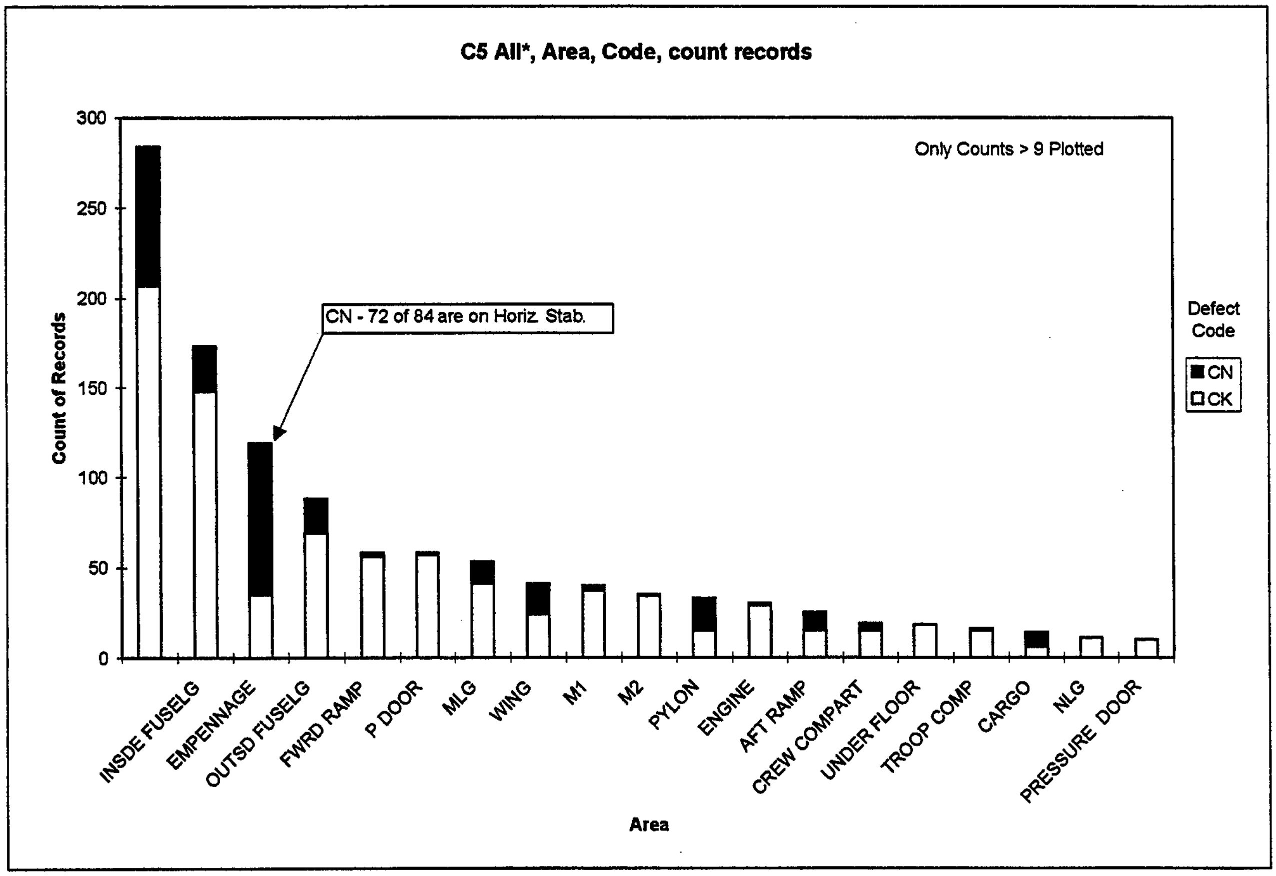


Figure 3.59 C5 ALC All, Count Records grouped by Airframe Area Location Term (Area) where the Discrepancy Descriptions included Corrosion (CN) or Crack (CK).

Table 3.62 C5 ALC All, Count Records by Grouped by PSE Key Word in the Discrepancy Field where the Damage Code indicated Corrosion (CN) or Crack (CK).

C5 All*, Area, Code, Descrip like *?*, count records

	Damage Code Count of Records		
Sum	181	541	722
Discrepancy w/	CN	CK	Sum
frame	2	164	166
beam	11	150	161
stab = stabilizer	76	31	107
skin	16	86	102
panel	63	37	100
bulk = bulkhead	3	54	57
string = stringer	10	19	29

Table 3.63 C5 ALC All, Count Records Grouped by the Damage Code for Corrosion (CN) and Crack (CK) and the Area Location (Area) where the PSE Key Word in the Discrepancy Field is "beam".

C5 All*, Area, Code, Descrip like *?*, count records

Discrepancy w/	beam	
Sum CK		150
Sum CN		11

Code	AREA	CountOfRecord
CK	INSDE FUSELG	54
CK		23
CK	MLG	19
CK	NLG	11
CK	ENGINE	8
CK	PYLON	8
CK	FWRD RAMP	4
CK	OUTSD FUSELG	3
CK	EMPENNAGE	2
CK	INSD FUSLG	2
CK	KEELBEAM	2
CK	PRESSURE DOOR	2
CK	VISOR	2
CK	]	1
CK	CARGO	1
CK	COCKPIT	1
CK	CREW COMPART	1
CK	CREW COMPARTMN	1
CK	INSIDE FUSLG	1
CK	M1	1
CK	M2	1
CK	OUTSD FUSLG	1
CK	P DOOR	1
CN	EMPENNAGE	4
CN		3
CN	AFT RAMP	2
CN	FT RAMP	1
CN	INSDE FUSELG	1

Table 3.64 C5 ALC All, Count Records Grouped by the Damage Code for Corrosion (CN) and Crack (CK) and the Area Location (Area) where the PSE Key Word in the Discrepancy Field is "frame".

C5 All*, Area, Code, Descrip like *?*, count records

Discrepancy w/	frame	
Sum CK		164
Sum CN		2

Code	AREA	CountOfRecord
CK		47
CK	INSDE FUSELG	28
CK	M2	20
CK	MLG	18
CK	M1	17
CK	UNDER FLOOR	15
CK	OUTSD FUSELG	9
CK	MAINFRAME	3
CK	M1 AREA	2
CK	EMPANNAGE	1
CK	EMPENNAGE	1
CK	FWRD RAMP	1
CK	P DOOR	1
CK	TROOP COMP	1
CN	CARGO	1
CN	INSDE FUSELG	1

Table 3.65 C5 ALC All, Count Records Grouped by the Damage Code for Corrosion (CN) and Crack (CK) and the Area Location (Area) where the PSE Key Word in the Discrepancy Field is "stab" (stabilizer).

C5 All*, Area, Code, Descrip like *?*, count records

Discrepancy w/	stab	
Sum CK		31
Sum CN		76

Code	AREA	CountOfRecord
CK	EMPENNAGE	20
CK	MLG	5
CK		4
CK	EMPENAGE	1
CK	MAINFRAME	1
CN	EMPENNAGE	71
CN		4
CN	EMPANNAGE	1

Table 3.66 C5 ALC All, Count Records Grouped by the Damage Code for Corrosion (CN) and Crack (CK) and the Area Location (Area) where the PSE Key Word in the Discrepancy Field is "<u>skin</u>".

C5 All*, Area, Code, Descrip like *?*, count records

Discrepancy w/	skin	
Sum CK		86
Sum CN		16

Code	AREA	CountOfRecord
CK	OUTSD FUSELG	26
CK	INSDE FUSELG	18
CK		15
CK	TROOP COMP	5
CK	WING	3
CK	AFT RAMP	2
CK	CARGO	2
CK	FWRD RAMP	2
CK	OUTSD FUSLG	2
CK	P DOOR	2
CK	UPPER LOBE	2
CK	VISOR	2
CK	EMPENNAGE	1
CK	INSD FUSLG	1
CK	INSIDE FUSLG	1
CK	LOWER LOBE	1
CK	MLG	1
CN		9
CN	OUTSD FUSELG	4
CN	EMPENNAGE	2
CN	AFT RAMP	1

Table 3.67 C5 ALC All, Count Records Grouped by the Damage Code for Corrosion (CN) and Crack (CK) and the Area Location (Area) where the PSE Key Word in the Discrepancy Field is "panel".

C5 All*, Area, Code, Descrip like *?*, count records		
Discrepancy w/	panel	
Sum CK		37
Sum CN		63

Code	AREA	CountOfRecord
CK	EMPENNAGE	8
CK	CREW COMPART	7
CK	TROOP COMP	7
CK	OUTSD FUSELG	4
CK		3
CK	P DOOR	3
CK	AFT RAMP	1
CK	EMPENAGE	1
CK	FWRD RAMP	1
CK	INSDE FUSELG	1
CK	KEELBEAM	1
CN	EMPENNAGE	41
CN		10
CN	AFT RAMP	4
CN	CREW COMPART	4
CN	WING	2
CN	CARGO	1
CN	EMPANNAGE	1

SECTION 4

Conclusions and Recommendations

4.1 Conclusions

The efforts performed under this program gathered and evaluated existing USAF maintenance data, assembled the data into a database, then used the database to identify airframe structural elements suffering from corrosion or fatigue cracking damage. The USAF aircraft fleets selected for consideration under this effort included the C/KC-135 Stratotanker, E-8C Joint STARS, C-9A/C Nightingale, C-130 Hercules, and C-5A/B Galaxy. The overall objective was to create a database, which is useful in identifying trends for the occurrence of corrosion and fatigue cracking damage to airframe Principal Structural Elements (PSEs). The database assembled under this effort contains individual records of inspection reports and repair orders, which have been obtained from USAF sources loosely categorized into two groups. First, standardized USAF maintenance data collections systems (MDCS) such as OACIS, AIRS, REMIS, and AFMC202. Second, other USAF programs funded to archive specific airframe damage and repair records. The databases can be used to identify PSEs, which may need further consideration of their structural integrity capability. The trends developed provide real and repeatable evidence to assist in focusing improvement efforts where the largest gains can be made.

For the C/KC-135, E-8C, C-9A/C, and C-130 fleets of USAF aircraft, some of the overall findings are that the number of records attributed to corrosion are much greater than the records attributed to fatigue cracking. The number of repair records for fatigue cracking may not be well represented by the maintenance data collected. Most fatigue cracks found on an airframe will likely be repaired with a standard repair not requiring a specific engineering action. Most of the data collected under this effort are from maintenance archival systems that only record information from repairs requiring an engineering disposition. Also, recall from the 707 wing tear down and inspections reported in Reference [18] that the large majority of cracks were very small (< 0.010 inches) and would not likely be found during a PDM refurbishment.

The airframe structural elements identified for these four fleets with the highest number of records are the “skins”. The term “skins” includes structural element terms such as panel, plank, and skin, which may be located on the fuselage and wing. For the KC-135, skins at the fuselage A/R (Ext.) and the wing skins (ext.) appear most frequently. For the E-8C, skins on the lower fuselage and the aft cargo section between BS 960 – 1440 appear most frequently. For the C-9A/C, wing skins and fuselage panels below the floor appear in the most records. Finally, for the C-130, the wing skins appear most frequently.

In the C-5A/B fleet of USAF aircraft, some of the overall findings are that the number of records attributed to fatigue cracking is somewhat higher than the records attributed to corrosion damage. The airframe structural elements identified with the highest number of records attributed to fatigue cracking damage are the fuselage beams & frames. For corrosion damage, the horizontal stabilizer was identified with the highest number of records.

Conclusions from this effort are that a viable database was assembled and a process defined to identify PSEs with corrosion and cracking damage. The results indicate that the USAF standardized data recording systems are sufficient to identify PSEs with corrosion and fatigue damage. However, there are no details in standard databases (MDCS) indicating multiple cracks or WFD. The many trial and error efforts to understand the usefulness of all the data gathered and combinations there-of indicate that PSEs can be related to DADTA points with extra data describing the DADTA points. Using the data for the C-130, corrosion & cracking record counts for PSEs are much greater than records counted for DADTA points. Supplemental data gathering efforts, such as aircraft disassembly and inspection programs, are valuable for substantiation of fleet wide trends, further insight, and additional data. The influence of corrosion damage on the structural integrity capability of some PSEs can be on the order of a 25% reduction in crack growth life. This life reduction due to corrosion occurring over several connecting PSEs could then reduce the fail-safety capability of the airframe.

4.2 Recommendations

For the selected USAF fleets, this effort has identified airframe structural elements and locations with relatively high numbers of records that report corrosion and fatigue cracking damage. Further evaluations are needed to assess the structural integrity capability of these PSEs with some consideration for the corrosion and fatigue cracking damage found. For each specific PSE and location, the data needed for these further evaluations includes the actual structural integrity assessment reports for the PSEs and better descriptions of the damage found.

The databases and the query processes developed under this effort have been shown to be able to identify emerging R&M (and possible safety) issues. A sustaining effort is needed to continue to collect and evaluate inspection and repair records for corrosion and fatigue cracking damage found on USAF aircraft. The payoff for improved R&M across the fleets is in quickly identifying and evaluating corroded PSEs. This database can identify corroded parts, quantify the extent of corrosion damage relative to other locations and lead to further evaluations of structural integrity. Further data collection can provide a return on investment for maintenance costs in identifying high drivers by dollars (cost of parts, labor, and down time).

The quality of the data in the databases has been shown to be inconsistent and in some cases unusable. Quality problems with the data include blank data, incorrect MDS, mixing of serial and tail numbers, and inconsistent terms identifying parts, locations and damage. The development of smart data entry systems is needed for the standardized MDCS. This will improve the confidence in the trends developed from these databases.

The definitions of work areas and zones used by the different fleets have been shown to be inconsistent. Creating standard work area and zone codes for transport aircraft will allow the trends developed for one fleet to be better compared to those of another fleet (i.e. E-8C and KC-135).

The use of DADTA point codes for developing damage trends affecting DADTA structural elements has been shown to be useful. The requirement for including the entry of applicable DADTA point codes is needed to better assure the accuracy of the trends developed for these types of PSEs.

SECTION 5

References

1. Swift, T., "Widespread Fatigue Damage Monitoring Issues and Concerns", 5th International Conference on Structural Airworthiness of New and Aging Aircraft, Hamburg, Germany, June 1993.
2. Damage Tolerance Assessment Handbook, Vol I & II, DOT/FAA/CT-93/69.1, January 1996.

C/KC-135 Stratotanker

3. Boeing Report, Document No.: D500-12641-1, Prepared by: R. Frank, Titled: "Laboratory Inspection Results - EC-135H 61-0291 Disassembly and Hidden Corrosion Program", Phase I, Released: January 1994.
4. Boeing Report, Document No.: D500-12641-2 & -3, Prepared by: R. Frank and R. Wolf, Titled: "Laboratory Inspection Results - EC-135H 61-0291 Disassembly and Hidden Corrosion Program", Phase II, Released: January 1994.
5. Boeing Report, Document No.: D500-12641-4, Prepared by: R. Frank and R. Wolf, Titled: "Laboratory Inspection Results - EC-135H 61-0291 Disassembly and Hidden Corrosion Program – Severe Corrosion Appendant", Released: January 1994.
6. Boeing Report, Document No.: D500-12641-5 through -10, Prepared by: R. Frank, Titled: "Laboratory Inspection Results - EC-135H 61-0291 Disassembly and Hidden Corrosion Program", Phase III, Released: January 1994 through May 1995.
7. Boeing Report, Document No.: D500-12641-11, Prepared by: R. Wolf, Titled: "Laboratory Inspection Results - EC-135H 61-0291 Disassembly and Hidden Corrosion Program - Final Summary", Released: 22 May 1995
8. Boeing Report, Prepared by: D. Kepler, Titled: "KC-135 E and R Economic Life Study", Document No.: D500-12868-1, Released: 19 September 1995.
9. USAF ASC/EN Report, KC-135 Blue Ribbon Panel Report, J. Lincoln, Report of the Blue Ribbon Panel on CORAL REACH, 29 July 1996.
10. Boeing Report, Prepared by: C. Womack (C/KC-135 DADTA Group), Titled: "C/KC-135 Aircraft Structural Integrity Program (ASIP) SUMMARY DOCUMENTATION", Document No.: D500-12445-1, Released: May 1994.
11. WL/FIBEC, *Compilation of DADTA crack growth data for selected C/KC-135 airframe structure related to the corrosion found on the EC-135H (61-0291)*, Prepared by :C. Paul.
12. Boeing Report, Prepared by: T. Derber (C/KC-135 DADTA Group), Titled: "C/KC-135 DADTA/FSMP Summary", Volumes I and II, Document No.: D500-11134-1 and -2, Released: June 1986.

E-8C Joint STARS

13. Boeing, Aging Airplane Corrosion Prevention and Control Program, 707/720 Task Card, Corrosion Task No. C53-133-02.
14. Grumman Melbourne Systems, Joint Stars, NDI/NDT Routine Maintenance Work Card, Work Card Number 57-572-204.
15. Boeing 707 Intercontinental Structural Repair, Figure 4 (sheet 2 of 2), Figure 5, Principal Structural Elements, (5 sheets), April 1969.
16. Boeing Report, Prepared by: A. Hug, Titled: "Laboratory Inspection of Wing Lower Surface Structure from 707 Aircraft for the J-Stars Program", Document No.: D500-12947-1, Released: 4 April 1996.

17. Boeing Letter (w/ Enclosure), Prepared by: J. Ford, Subject: Contract F34601-92-C-0272, Umbrella Engineering Services Contract, Document No.: Y-7WH8-JPF-96-061, Released: 7 June 1996, Enclosure: Boeing Memo 3-7DM2-2015-96/LLW:AJH:kw, dated 21 May 1996, "J-STARS Support - Oversizing of Cracked Fastener Holes from 707 Wing Teardown".

18. Boeing Letter (w/ Attachments), Prepared by: J. Ford, Subject: Contract F34601-92-C-0272, Umbrella Engineering Services Contract, Document No.: Y-7WH8-JPF-96-041, Released: 19 April 1996, Attachments: A - "Fracture Mechanics Crack Growth Analysis and Data Reduction of Teardown inspection Results", B - "Lower Wing Panel Residual Strength Analysis Finite Element Model", C - "Boeing 707-100 Fastener Infomation for Stiffener to Wing Skin Fasteners From Side of Body to Wing Station 360 Splice", D - Boeing 707-300 Lower Surface Skin Unit Stress Contours Applicable to J-STARS Lower Wing Surface Residual Strength Analysis".

19. "Corrosion and Fatigue Study of (2) JSTARS Aircraft", A. K. Pun, et el., WL/FIBE, WL-TR-3093, Volume 1 & 2, April 1997.

<u>C-130 Hercules</u>

20. Lockheed Report, Prepared by: ---, Titled: "Section IX, C-130 Corrosion and Structural Repair Tracking", Document No.: TO-1C-130A-23, Released: ---, *Explanation of fields in the C-130 AIRS Database*.

21. ARINC Report, Prepared by: M. Howard, Titled: "Final Report - Extent of Corrosion Damage on Critical Structural Components of the USAF C-130 Aircraft", Volume I: Summary and Critical Component Data, Released: October 1996.

22. ARINC Report, Prepared by: M. Howard, Titled: "Final Report - Extent of Corrosion Damage on Critical Structural Components of the USAF C-130 Aircraft", Volume II: Critical Component Illustrations, Released: October 1996.

<u>C-5A/B Galaxy</u>

23. Lockheed Report, Prepared by: K. Hall, Titled: C-5 Fracture Analysis, Document No.: LG93ER0022, Released: September 1993.
Section 2: Structural Description and Analysis Locations
Section 3: Summary of Crack Growth and Fatigue Analysis Results

24. Lockheed - Georgia Company Report, Prepared by: Staff, C-5 Fatigue and Fracture Analysis Group (R. W. Black and R. L. Circle), Titled: "C-5A Fracture Analysis - Volume II", Book 1 and Book 2, Reference: LG1-D1-S-3591-1, Rev. A, 31 May 1974, Original 15 May 1973.

APPENDIX 1

USAF Fact Sheets of Selected Aircraft

USAF AIRCRAFT
FACT SHEETS

SOURCE: Air Force Link (www.af.mil)
Select ⇒ Library
Select ⇒ Fact Sheets

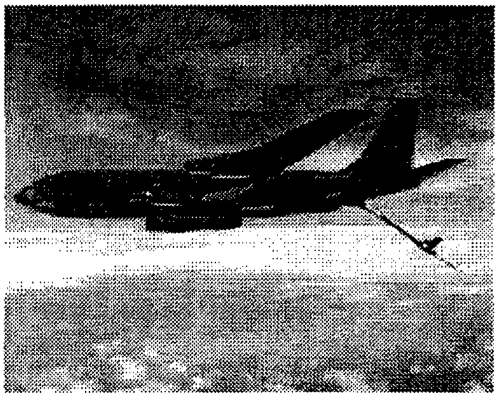
Included here are excerpts from the following USAF Fact Sheets:

- KC-135 Stratotanker, USAF FACT SHEET 92-21
- E-8C Joint STARS, USAF FACT SHEET
- C-9A/C Nightingale, USAF FACT SHEET 92-42
- C-5A/B Galaxy, USAF FACT SHEET 92-35
- C-130 Hercules, USAF FACT SHEET 92-34

USAF FACT SHEET 92-21

www.af.mil/news/factsheets/KC_135_stratotanker.html

KC-135 Stratotanker



Mission

The KC-135 Stratotanker's primary mission is to refuel long-range bombers. It also provides aerial refueling support to Air Force, Navy, Marine Corps and allied aircraft.

Features

Four turbojets, mounted under wings swept 35 degrees, power the KC-135. Nearly all internal fuel can be pumped through the tanker's flying boom, the KC-135's primary fuel transfer method. A special shuttlecock-shaped drogue, attached to and trailed behind the flying boom, is used to refuel aircraft fitted with probes. An operator stationed in the rear of the plane controls the boom. A cargo deck above the refueling system holds passengers or cargo. Depending on fuel storage configuration, the KC-135 can carry up to 83,000 pounds (37,350 kilograms) of cargo.

Background

The Boeing Military Airplane Company's model 367-80 was the basic design for the commercial 707 passenger plane as well as the KC-135A Stratotanker. In 1954 the Air Force purchased the first 29 of its future fleet of 732. The first aircraft flew in August 1956 and the initial-production Stratotanker was delivered to Castle Air Force Base, Calif., in June 1957. The last KC-135A was delivered to the Air Force in 1965.

In Southeast Asia, KC-135 Stratotankers made the air war different from all previous aerial conflicts. Mid-air refueling brought far-flung bombing targets within reach. Combat aircraft, no longer limited by fuel supplies, were able to spend more time in target areas.

The KC-135A's are being modified with new CFM-56 engines produced by CFM-international. The re-engined tanker, designated the KC-135R, can off load 50 percent more fuel, is 25 percent cheaper to operate and is 96 percent quieter than the KC-135A.

Under another modification program, all Air Force Reserve and Air National Guard tankers were re-engined with TF-33-PW-102 engines. The re-engined tanker, designated the KC-135E, is 14 percent more fuel efficient than the KC-135A and can carry 20 percent more fuel.

With projected modifications, the KC-135 will fly and refuel into the next century. A new aluminum-alloy skin grafted to the underside of the wings will add 27,000 flying hours to the aircraft.

The KC-135 tanker fleet made an invaluable contribution to the success of Operation Desert Storm in the Persian Gulf, flying around-the-clock missions to maintain operability of allied warplanes. The KC-135s form the backbone of the Air Force tanker fleet, meeting the aerial refueling requirements of bomber, fighter, cargo and reconnaissance forces, as well as the needs of the Navy, Marines and allied nations.

General Characteristics (KC-135R)

Primary Function: Aerial refueling

Contractor: Boeing Military Airplanes

Power Plant: Four CFM-International F108-CF-100 turbofans

Thrust: 22,224 pounds (10,000.8 kilograms) each engine

Length: 136 feet, 3 inches (40.8 meters)

Height: 38 feet, 4 inches (11.5 meters)

Wingspan: 130 feet, 10 inches (39.2 meters)

Speed: Maximum speed at 30,000 feet (9,100 meters) 610 mph (Mach 0.93)

Ceiling: 50,000 feet (15,152 meters)

Weight: 119,231 pounds (53,654 kilograms) empty

Maximum Takeoff Weight: 322,500 pounds (145,125 kilograms)

Range: 11,192 miles (9,732 nautical miles) with 120,000 pounds (54,000 kilograms) of transfer fuel.

Crew: Four or five; up to 80 passengers.

Date Deployed: August 1965.

Unit Cost: KC-135R, $53 million; KC-135E, $30.6 million; KC-135A, $26.1 million.

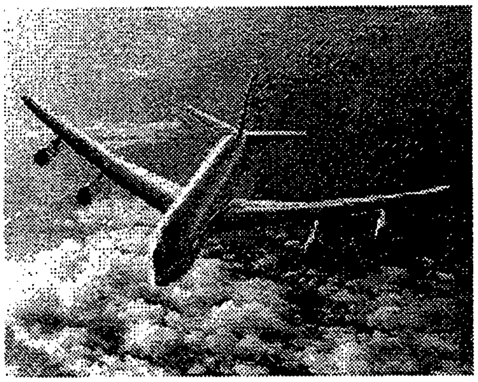
Inventory: Active force, 457; Reserve, 30; ANG, 158.

Point of Contact: Air Mobility Command, Public Affairs Office; 502 Scott Drive; Scott AFB, IL 62225-5317; DSN 576-5004 or (618) 256-5004.

USAF FACT SHEET

www.jstars.af.mil/e-8.html

E-8C - Joint STARS



Mission

The Joint Surveillance Target Attack Radar System (Joint STARS) is a long-range, air-to-ground surveillance system designed to locate, classify and track ground targets in all weather conditions. While flying in friendly airspace, the joint Army-Air Force program can look deep behind hostile borders to detect and track ground movements in both forward and rear areas. It has a range of more than 120 miles (200 km). These capabilities make Joint STARS effective for dealing with any contingency, whether actual or impending military aggression, international treaty verification, or border violation.

Features

Joint STARS consists of an airborne platform--an E-8C aircraft with a multi-mode radar system--and U.S. Army mobile Ground Station Modules (GSMs).

The E-8C, a modified Boeing 707, carries a phased-array radar antenna in a 26-foot canoe-shaped radome under the forward part of the fuselage. The radar is capable of providing targeting and battle management data to all Joint STARS operators, both in the aircraft and in the ground station modules. These operators, in turn, can call on aircraft, missiles or artillery for fire support.

Wide Area Surveillance and Moving Target Indicator (WAS/MTI) are the radar's fundamental operating modes. WAS/MTI is designed to detect, locate and identify slow-moving targets. Through advanced signal processing, Joint STARS can differentiate between wheeled and tracked vehicles. By focusing on smaller terrain areas, the radar image can be enhanced for increased resolution display. This high resolution is used to define moving targets and provide combat units with accurate information for attack planning.

Synthetic Aperture Radar/Fixed Target Indicator (SAR/FTI) produces a photographic-like image or map of selected geographic regions. SAR data maps contain precise locations of critical non-moving targets such as bridges, harbors, airports, buildings, or stopped vehicles.

The FTI display is available while operating in the SAR mode to identify and locate fixed targets within the SAR area. The SAR and FTI capability used in conjunction with MTI and MTI history display allows post-attack assessments to be made by onboard or ground operators following a weapon attack on hostile targets.

Joint STARS operates in virtually any weather, on-line, in real-time, around the clock. The augmented Army-Air Force mission crew can be deployed to a potential trouble spot within hours and provide valuable data on ground force movements.

Major advanced technological elements of the program include the software-intensive radar with several operating modes; the unique antenna with three receive ports; four high-speed processors capable of performing more than 600 million operations per second; and the associated software.

Background

The E-8A preproduction model was owned exclusively by Northrop Grumman Corp. Although still under development, two aircraft deployed in 1991 to participate in Desert Storm. Joint STARS was praised for tracking mobile Iraqi forces, including tanks and Scud missiles. The crew flew 49 combat sorties accumulating more than 500 combat hours and a remarkable 100 percent mission effectiveness rate.

The E-8C is the production model owned by the Air Force. From December 1995 to March 1996 the E-8A and E-8C showed their flexibility while supporting the NATO peacekeeping mission in Bosnia. Operation Joint Endeavor proved Joint STARS is effective despite adverse weather conditions and rough terrain. The crew flew 95 consecutive operational sorties and more than 1,000 flight hours with a 98 percent mission effectiveness rate.

The first E-8C was handed over to the 93rd Air Control Wing at Robins AFB, Ga., on June 11, 1996.

General Characteristics

Primary Function: Ground Surveillance

Contractor: Northrop Grumman Corp.

Power Plant: Four JT3D engines

Length: 152'11"

Height: 42'6"

Weight: 171,000 pounds -- Empty

155,000 pounds -- Max Fuel

336,000 pounds -- Max Gross

Wingspan: 145'9"

Speed: .84 Mach

Range: 11 hours -- 20 hours with air refueling

Unit Cost: $850 million

Crew: Flight crew of 4 plus mission crew of 18 Army and Air Force specialists (mission crew size varies according to mission)

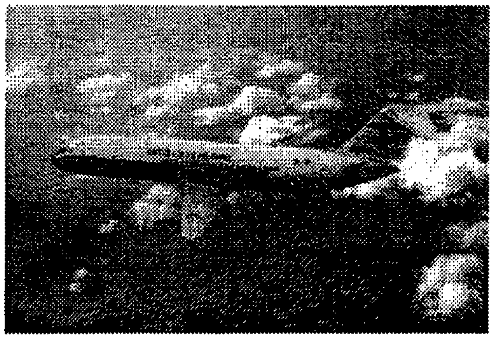
Date Deployed: 1996

Inventory: Active force, 1(19 to be delivered to Air Force by 2004); ANG, 0; Reserve, 0

USAF FACT SHEET 92-42

www.af.mil/news/factsheets/C_9A_C_nightingale.html

C-9A/C Nightingale



Mission

The C-9 is a twin-engine, T-tailed, medium-range, swept-wing jet aircraft used primarily for Air Mobility Command's aeromedical evacuation mission.

Features

The Nightingale is a modified version of the McDonnell Douglas Aircraft Corporation's DC-9. It is the only aircraft in the inventory specifically designed for the movement of litter and ambulatory patients.

The C-9A's airlift capability to carry 40 litter patients, 40 ambulatory and four litter patients, or various combinations thereof, provides the flexibility for Air Mobility Command's worldwide aeromedical evacuation role.

A hydraulically operated folding ramp allows efficient loading and unloading of litter patients and special medical equipment.

Background

The 375th Airlift Wing at Scott Air Force Base, Ill., operates C-9A Nightingales for Air mobility Command. C-9A's are assigned to the 374th Airlift Wing at Yokota Air Base, Japan, for use in the Pacific theater. C-9s also are assigned to the 435th Airlift Wing at Rhein-Main Air Base, Germany, for use in the European and Middle East theater.

The C-9A Nightingale demonstrates its uniqueness and versatility daily by its ability to serve not only military, but Department of Veterans Affairs and civilian hospitals throughout the world, using military and commercial airfields.

General Characteristics

Primary Function: Aeromedical evacuation

Contractor: McDonnell Douglas Corporation

Power Plant: Two Pratt & Whitney JT8D-9A turbofan engines

Thrust: 14,500 pounds (6,525 kilograms) each engine

Length: 119 feet, 3 inches (35.7 meters)

Wingspan: 93 feet, 3 inches (27.9 meters)

Height: 27 feet, 5 inches (8.2 meters)

Maximum Takeoff Weight: 108,000 pounds (48,600 kilograms)

Range: More than 2,000 miles (1,739 nautical miles)

Ceiling: 35,000 feet (10,606 meters)

Speed: 565 mph (Mach 0.86) at 25,000 feet (7583.3 meters), with maximum takeoff weight

Load: 40 litter patients or four litters and 40 ambulatory patients or other combinations

Crew: Eight (pilot, co-pilot, flight mechanic, two flight nurses and three aeromedical technicians)

Date Deployed: August 1968

Unit Cost: $17 million

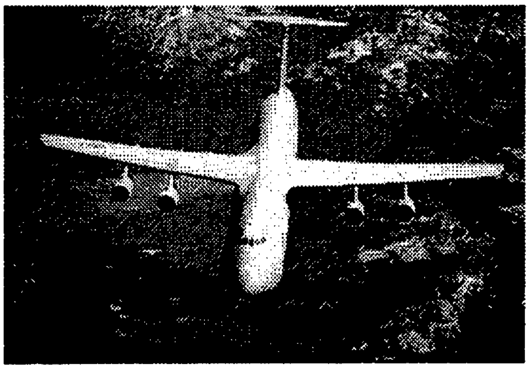
Inventory: Active force, 10; ANG, 0; Reserve, 0

Point of Contact: Air Mobility Command; Public Affairs Office; Scott AFB, IL 62225-5317; DSN 576-5003 or (618) 256-5003.

USAF FACT SHEET 92-35

www.af.mil/news/factsheets/C_5A_B_galaxy.html

C-5A/B Galaxy



Mission

The C-5 Galaxy is a heavy-cargo transport designed to provide massive strategic airlift, for deployment and supply of combat and support forces.

Features

The C-5 can carry unusually large and heavy cargo for intercontinental ranges at jet speeds. The plane can take off and land in relatively short distances and taxi on substandard surfaces during emergency operations. The C-5 and the smaller C-141B Starlifter are strategic airlift partners. Together they carry fully equipped, combat-ready troops to any area in the world on short notice and provide full field support necessary to maintain a fighting force.

Using the front and rear cargo openings, the Galaxy can be loaded and off-loaded at the same time. Both nose and rear doors open the full width and height of the cargo compartment, allowing drive-through loading and unloading of wheeled and tracked vehicles, and faster, easier loading of bulky equipment. A "kneeling" landing gear system lowers the aircraft's cargo floor to truck-bed height. The entire cargo floor has a roller system for rapid handling of palletized equipment. Thirty-six fully loaded pallets can be loaded aboard in about 90 minutes.

The Galaxy's weight is distributed on its high flotation landing gear, which has 28 wheels. The landing gear system can raise each set of wheels individually for simplified tire changes or brake maintenance.

An automatic trouble-shooting system constantly monitors more than 800 test points in the various subsystems of the C-5. The Malfunction Detection Analysis and Recording System uses a

digital computer to identify malfunctions in replaceable units. Failure and trend information is recorded on magnetic tape for analysis.

Four turbofan engines mounted on pylons under the wings power the C-5. Each engine pod is nearly 27 feet (8.2 meters) long, weighs 7,900 pounds (3,555 kilograms) and has an air intake diameter of more than 8 1/2 feet (2.6 meters). The Galaxy has 12 integral wing tanks with a capacity of 51,150 gallons (194,370 liters) of fuel - enough to fill 6 1/2 regular-size railroad tank cars. The fuel weighs 322,500 pounds (145,125 kilograms) and permits the C-5, carrying a 204,904-pound (92,207-kilogram) payload, to fly 2,150 nautical miles (3,440 kilometers), off-load, and fly another 500 miles (800 kilometers) without aerial refueling.

Except for emergencies or unusual circumstances, the C-5 does not carry troops in the lower-deck cargo compartment; but 73 seats are available in the rear compartment of the upper deck for personnel and operators of equipment being airlifted. The C-5 has carried special loads, such as large missiles, that would require extra time, manpower and dollars to transport via ship, rail or flatbed truck.

The forward upper deck accommodates a crew of six, a relief crew of seven, and eight mail or message couriers. The flight deck has work stations for the pilot, co-pilot, two flight engineers and two loadmasters. The upper deck's forward and rear compartments have galleys for food preparation, as well as lavatories.

The Galaxy has sophisticated communications equipment and a triple inertial navigation system, making it nearly self-sufficient. It can operate without using ground-based navigational aids.

The electrical system has four engine-driven generators, each powerful enough to supply the aircraft sufficient electricity. Each of the two main landing gear pods carries an auxiliary power unit to supply electric and pneumatic power for engine starts and ground air conditioning, heating, cooling and ventilation. Air turbine motors in the landing gear pods also can power the hydraulic systems and the main landing gear kneeling motors.

Background

The Galaxy is one of the world's largest aircraft. It is almost as long as a football field and as high as a six-story building and has a cargo compartment about the size of an eight-lane bowling alley. The C-5 is the only aircraft that can transport any of the Army's combat equipment, including the 74-ton (66,600-kilogram) mobile scissors bridge, tanks and helicopters.

The first C-5A was delivered to the Transitional Training Unit at Altus Air Force Base, Okla., in December 1969. The first operational C-5s were delivered to the 437th Military Airlift Wing, Charleston Air Force Base, S.C., in June 1970. In December 1984, the 433rd Tactical Airlift Wing (now the 433rd Military Airlift Wing) at Kelly Air Force Base, Texas, became the first Air Force Reserve wing equipped with C-5 Galaxies.

The first C-5B incorporating significant improvements such as strengthened wings and updated avionics was delivered to Altus Air Force Base in January 1986. C-5 production concluded with delivery of the last "B" model aircraft in April 1989.

The C-5, with its massive payload capability, has opened unprecedented dimensions of strategic airlift in support of national defense. For 20 years it has been involved in many historic airlift missions, and is invaluable to the Air Force mission and humanitarian efforts. For example, in December 1988, four C-5s participated in the delivery of more than 885,000 pounds (398,250 kilograms) of earthquake relief supplies to the then Soviet Republic of Armenia. The C-5 also assisted with an Alaskan oil spill cleanup in March 1989, transporting nearly 2 million pounds (900,000 kilograms) of equipment to Elmendorf Air Force Base, Alaska.

The most dramatic display of the Galaxy's capability and value was during operations Desert Shield and Desert Storm. The C-5, along with other Air Force transport aircraft, airlifted almost a half-million passengers and more than 577,000 tons (519,300 metric tons) of cargo. This included 15 air-transportable hospitals and the more than 5,000 medical personnel to run them, and more than 211 tons (189.9 metric tons) of mail to and from the men and women in the Middle East - each day.

General Characteristics

Primary Function: Massive strategic airlift.

Contractor: Lockheed-Georgia Co.

Power Plant: Four General Electric TF39-GE-1C turbofan engines.

Thrust: 41,000 pounds (18,450 kilograms), each engine.

Length: 247 feet, 10 inches (75.3 meters).

Height At Tail: 65 feet, 1 inch (19.8 meters).

Maximum Takeoff Weight: 769,000 pounds (346,500 kilograms).

Maximum Wartime Takeoff Weight: 840,000 pounds (378,000 kilograms).

Takeoff/Landing Distances: 12,200 feet (3,697 meters) takeoff fully loaded; 4,900 feet (1485 meters) land fully loaded.

Wingspan: 222 feet, 9 inches (67.9 meters).

Stabilizer Span: 68 feet, 9 inches (20.8 meters).

Cargo Compartment: Height 13.5 feet (4.10 meters); width 19 feet (5.76 meters).

Range: 5,940 miles (5,165 nautical miles) empty.

Ceiling: 34,000 feet (10,303 meters) with a 605,000-pound (272,250-kilogram) load.

Speed: 541 mph (Mach 0.72)

Load: 291,000 pounds (130,950 kilograms) maximum wartime payload.

Accommodations: Upper deck seats 73 passengers; forward upper deck seats six, a relief crew of seven, and eight mail or message couriers. The flight deck has work stations for the entire crew. The upper deck's forward and rear compartments have galleys for food preparation and lavatories.

Sensors: An automatic trouble-shooting system constantly monitors more than 800 test points in the various subsystems of the C-5. The Malfunction Detection Analysis and Recording System uses a digital computer to identify malfunctions in replaceable units. Failure and trend information is recorded on magnetic tape for analysis by maintenance people.

Unit Cost: C-5A, $163.4 million; C-5B, $167.7 million

Crew: Six (pilot, co-pilot, two flight engineers, two loadmasters)

Date Deployed: December 1969 (for training); June 1970 (operational); December 1984 (to Reserve).

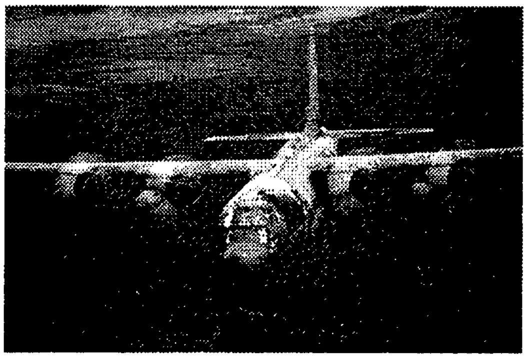
Inventory: Active-force, 70; ANG, 11; Reserve, 28.

Point of Contact:

Air Mobility Command; 502 Scott Drive; Scott AFB, IL 62225-5317; DSN 576-4502 or (618) 256-4502.

www.af.mil/news/factsheets/C_130_hercules.html

C-130 Hercules



Mission

The C-130 Hercules primarily performs the intratheater portion of the airlift mission. The aircraft is capable of operating from rough, dirt strips and is the prime transport for paradropping troops and equipment into hostile areas.

Background

Four decades have elapsed since the Air Force issued its original design specification, yet the remarkable C-130 remains in production. The initial production model was the C-130A, with four Allison T56-A-11 or -9 turboprops. A total of 219 were ordered and deliveries began in December 1956. Two DC-130A's (originally GC-130A's) were built as drone launchers/directors, carrying up to four drones on underwing pylons. All special equipment was removable, permitting the aircraft to be used as freighters, assault transports, or ambulances. The C-130B introduced Allison T56-A-7 turboprops and the first of 134 entered Air Force service in April 1959. C-130B's are used in aerial fire fighting missions by Air National Guard and Air Force Reserve units. Six C-130B's were modified in 1961 for snatch recovery of classified U.S. Air Force satellites by the 6593rd Test Squadron at Hickam Air Force Base, Hawaii.

Features

In its personnel carrier role, the C-130 can accommodate 92 combat troops or 64 fully equipped paratroops on side-facing seats. For medical evacuations, it carries 74 litter patients and two medical attendants. Paratroopers exit the aircraft through two doors on either side of the aircraft behind the landing-gear fairings. Another exit is off the rear ramp for airdrops.

The C-130 Hercules joins on mercy flights throughout the world, bringing in food, clothing, shelter, doctors, nurses and medical supplies and moving victims to safety.

C-130 Hercules have served other nations, airlifting heavy equipment into remote areas to build airports and roads, search for oil ,and transport local goods.

As a partial response to the overwhelming role played by the tactical airlift fleet in Operation Just Cause and in the Persian Gulf War, Congress has approved the procurement of more C-130H's to replace the aging E models.

General Characteristics

Primary Function: Intratheater airlift.

Contractor: Lockheed Aeronautical Systems Company.

Power Plant: Four Allison T56-A-15 turboprops; 4,300 horsepower, each engine.

Length: 97 feet, 9 inches (29.3 meters).

Height: 38 feet, 3 inches (11.4 meters).

Wingspan: 132 feet, 7 inches (39.7 meters).

Speed: 374 mph (Mach 0.57) at 20,000 feet (6,060 meters).

Ceiling: 33,000 feet (10,000 meters) with 100,000 pounds (45,000 kilograms) payload.

Maximum Takeoff Weight: 155,000 pounds (69,750 kilograms).

Range: 2,356 miles (2,049 nautical miles) with maximum payload; 2,500 miles (2,174 nautical miles) with 25,000 pounds (11,250 kilograms) cargo; 5,200 miles (4,522 nautical miles) with no cargo.

Unit Cost: $22.9 million (1992 dollars).

Crew: Five (two pilots, a navigator, flight engineer and loadmaster); up to 92 troops or 64 paratroops or 74 litter patients or five standard freight pallets.

Date Deployed: April 1955.

Inventory: Active force, 98; ANG, 20 Bs, 60 E's and 93 H's; Reserve, 606.

APPENDIX B

Excerpts from the 1997 AMMP, Air Mobility Master Plan

1997 AMMP
Air Mobility Master Plan

SOURCE: Air Force Link (www.af.mil)
Select ⇒ Sites
Select ⇒ Air Mobility Command (AMC)
Select ⇒ Air Mobility Master Plan (AMMP)

Included here are excerpts from the following sections of the AMMP

- Executive Summary
- C-5 WEAPON SYSTEM
- KC-135 WEAPON SYSTEM
- AEROMEDICAL EVACUATION (AE)

EXECUTIVE SUMMARY

Our present core airlifter, the C-141 Starlifter, was designed to carry Army equipment of the 1960s. This system, first flown in 1963, is rapidly approaching the end of its service life and has experienced recurring structural problems limiting its operational capability. In the short-term, we will concentrate on repairing those aircraft with remaining service life. Major modifications include a new autopilot and All Weather Landing System (AWLS), Global Positioning System (GPS), Airlift Defensive System (ADS), and more accurate fuel quantity indicators. These modifications are required to maintain the C-141 as an effective weapon system for the next 10 years. To minimize unnecessary costs, the youngest 63 aircraft will receive these upgrades and are termed the "ARC Core 63." We plan to retire active duty C-141s by FY03 and Unit Equipped (UE) ARC aircraft by FY06.

...

The C-5 Galaxy provides a significant portion of AMC's cargo capability, but of AMC's major weapons systems, the C-5A has the lowest mission capable and departure reliability rates. Because of these problems and the C-5A's increasing operating costs, we will study its economic service life to identify the best time to begin its replacement. Until this study is complete, AMC will advocate the replacement of the C-5A beginning in FY07. In the short to mid-term, AMC will concentrate on increasing C-5 fleet effectiveness by implementing a capital investment plan focused on improving reliability, maintainability, availability and lowering cost of ownership. Careful analysis of each modification is critical to ensuring the best use of resources.

...

Air refueling provides the flexibility necessary to provide Global Reach on short notice and for extended periods of time. The KC-135 is our core tanker. The Q and some E models are completing the R-model conversion which increases mission effectiveness by enhancing offload capability and reducing operating costs. Additionally, the KC-135 fleet is making a further mobility contribution as a strategic airlifter. While carrying a small cargo load, its long range and high cruise speed make it suitable to fill a specialized niche in an airlift role. Corrosion is impacting our ability to accurately predict the KC-135 service life. AMC must be able to quantify the impact of corrosion on KC-135 service life to allow timely force structure decisions. If possible, AMC will retain the KC-135 through at least a 56-year service life, and its replacement, the KC-X, should be ready to enter the inventory by FY13.

...

The primary Air Force aircraft supporting the Operational Support Airlift mission is the C-21. Because this is a relatively new aircraft, the plan calls only for avionics upgrades to ensure the system continues to operate in the most effective and efficient manner. Studies should begin by FY06 to determine the continued viability of the C-21. The Special Air Mission (SAM) uses a

variety of aging aircraft to meet its high visibility requirements. The VC-X, the C-137 replacement, has been funded but the UH-1N replacement, although validated, awaits funding. The C-20B, C-9A, and C-9C do not meet civilian Stage III noise standards. Because these aircraft transit civil fields due to mission requirements, they require either hush kits, engineering, or memorandums of understanding with civilian airfield managers.

C-5 WEAPON SYSTEM

The C-5 is a vital asset, capable of deploying combat and support personnel, supplies and equipment, particularly outsized and heavy cargo between CONUS and overseas locations. The C-5A entered service in 1969 with 50 additional C-5Bs entering in service in the mid 1980s. Until the C-17 is fully fielded, the C-5 represents most of AMC's capability to carry outsize cargo. It can routinely carry 73 troops and 36 standard 463L pallets. There is a limited airbus configuration to carry 346 passengers; however, there are only 4 kits in the Air Force inventory. Because of its size and lack of ground agility, routine C-5 operations are restricted to main operating bases.

Extended Programmed Depot Maintenance (PDM) Interval
After 72 months in service, only minor defects were found on the first eight C-5B PDM baseline inspections. Considering the results of these inspections, the inspection interval has been changed from 72 to 84 months in FY95.

Reduced ISO Inspection by Field Units
With the establishment C-5 Blue Suit Maintenance Teams at San Antonio Air Logistics Center, AMC units no longer accomplish an ISO inspection on their aircraft upon returning from PDM. The Blue Suit Maintenance Team accomplishes an ISO on each aircraft as it goes through PDM. This program increases the aircraft availability by 0.4 aircraft per day.

Reliability
Reliability of the C-5, in particular the A-model, is a top concern of the command. The mission capable rate for the A-model continues as the lowest in the command at 58.8 percent (CY95) and is approximately 10 percent below the B-model. Departure reliability also lags behind other aircraft on average by 3 to 13 percent (CY95). Air abort and break rates should decrease as the C-5 is modernized with systems which meet the mean time between failure performance typical of the aviation industry. However, due to the funding and implementation time associated with modifications, it will be several years before their effects become evident. Continued modernization of the C-5 aircraft should lead to decreasing TNMCM and TNMCS rates of 8 and 5 percent respectively by FY15, with aircraft availability improving by 10 percent as well by this time. These improvements will increase departure reliability rates, however, concern for the C-5A still remains. With this improvement, the A-model still would not meet the AMC rate planning factor of 75 percent. The reliability performance of the A-model is poor enough that the ability to operate it in a cost effective manner in the future is questionable.

Modifications
Ensuring the C-5 remains a viable mobility asset requires ongoing updates, repairs and improved (preferred) spares. The capital investment plan for the C-5 is developed through the C-5 IPT with input from Air Staff, AMC, AFMC, SA-ALC, and industry. The IPT is guided by four objectives. The first objective, improving reliability and maintainability, is our biggest concern and receiving the most priority at this time. The second is to maintain the weapon system's integrity - avoiding problems similar to those that the C-141 experienced. The third objective is to reduce the C-5's operating costs which often goes hand in hand with improving reliability. The final objective is to increase capability. Airdrop modifications for the C-5B are critical to AMC meeting the strategic brigade airdrop requirement. Program management through the C-5 IPT will work to ensure a viable service life through cost effective modifications.

Objective 2.2.1
Increase aircraft availability and reliability to meet command goals and requirements.

Modification Summaries
The following paragraphs give a brief synopsis of the major modifications currently programmed for the aircraft:

Fan Blade Repair: The stage two fan blade mid span has had several inflight failures causing fan blades to depart the engine and on two occasions penetrate the fuselage. The solution is to reinforce the fan blade with a titanium insert. This insert will strengthen the fan blade by 40%.

Engine High Pressure Turbine: Replaces a high failure rate turbine with a more durable turbine which also allows rated thrust takeoffs at higher temperatures.

...

Main Landing Gear Actuation System: Modifies unreliable C-5A system to C-5B configuration, eliminating 8 gearboxes and several torque tubes. Greatly simplifies landing gear R&M. Increases MTBF from 70 to 625 hours.

...

Troop Compartment Floor Corrosion Prevention: Replaces the leak-prone A-model troop latrine with a one piece fiberglass floor pan, fiberglass walls, and a larger holding tank to stop leaks and prevent corrosion of the compartment floor. This floor area is composed of stress panels for the aircraft.

Cockpit/Courier Floor Stress Panel: Damaged flooring and substructures will be replaced with materials similar to those on the C-5B. The cockpit, relief crew, and courier floors and subfloors require extensive repair due to corrosion and delamination. Replacement of materials will mitigate this damage.

...

Improved Bolting Nozzle Seal: Prevents engine replacement due to damaged low pressure turbine blades caused by failure of the stage two and stage three interstage seal bolts.

Thrust Recovery / Cabin Outflow Drain: Moves a water drain line and adds flapper valves to prevent clogging of the drain. Clogging of this drain causes water to collect in the underfloor and promotes corrosion of the pork chop fittings. This low cost mod ($1.3M for the entire fleet) prevents having to do expensive structural repair at a cost of over $1M per airplane.

Stage 2 Fan Blade Retainer: Prevents relative motion between the blades and disk. This will eliminate the wear on the mid span platform surfaces and reduces maintenance costs.

Smart Engine Diagnostics: This modification provides "smart engine diagnostics" capability to give more accurate and precise data for maintenance which will reduce aircraft and engine downtime. The current MADARS monitoring and diagnostics system uses outdated technology which results in increased maintenance man-hours and aircraft downtime.

Sustaining Engineering

To sustain the baseline capabilities of the C-5 and associated non-aircraft systems, the command is contracting engineering services. Contractors will analyze reliability, maintainability, supportability, and performance deficiencies. The engineering efforts requiring funding are identified in the sustaining engineering requirement plan (SERP) and are listed below. The studies will verify the need for change, develop life-cycle costs, and perform trade-off analysis. The studies may lead to further research, development, testing, and evaluation (RDT&E) initiatives and future modifications to the aircraft. This effort covers the future-years defense program (FYDP) period.

TASKS
Aircraft Structural Integrity Program
Functional System Integrity Program
Environmental Protection Directives
TPS/OFP Software Deficiency Analysis
Mishap Investigations
Mission Critical Rapid Response
Systems Engineering Support
Landing Gearing Engineering Support
Engineering Configuration Support
Corrosion Control Program
Modernization Feasibility Support
Trainer Engineering Support
Technology Applications Program
Ground Support Equipment Program

Service Life

The Air Force took delivery of the first C-5A in 1969. The force was then retrofitted with

a new wing in the mid 1980s. With a projected structural service life of 30,000 hours, the C-5 could last structurally well into the next century, depending on the model and other factors. However, system obsolescence, reliability and maintainability, operating cost, impacts of corrosion, and required repairs all factor in the service life of an aircraft. Currently, the C-5 has the highest operating cost of any weapon system, and the trend is a rise in tariff rates and reliability and maintainability costs for the C-5. The current maintenance man hour per flying hour illustrates the difficulties in the C-5 force. The A models consume approximately 56.2 maintenance man hours per flying hour, 29.3 for the B model. With the retirement of the C-141 force, the C-5 will take a larger role in peacetime movement of cargo over the next few years. This means our mobility customers will face a more expensive option with the C-5. Over the past years, our depot levels have increased to over 20 percent of our total aircraft relative to the planned 15.4 percent BAI levels. Also, the daily mission capable rate over the past years has continued to fall, with the A-model averaging about 13.5 percent below the B-model. These problems raise concern for the economic life of the C-5 A-model.

To a large extent, the economic service life will depend on our ability to modernize the fleet with technology that improves structural integrity, restores aircraft reliability and availability, and reduces cost of ownership. With inputs from the C-5 IPT, AFMC, the depot, and Lockheed Corporation, AMC will determine a specific course of action for both the A and B models that works toward these objectives. The question still remains, given the A-model's high operating cost and low mission capability rate, can it maintain economic viability? Studies and analysis will examine different options dealing with the C-5A problem and weigh the costs of replacement verses continued high operating costs and required repairs and modifications. Notionally, if the C-5A is retired at the same age as the C-141, it will begin retirement from service in FY07.

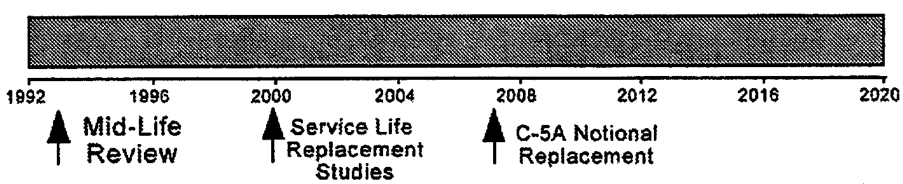


Figure 5-10. C-5A Service Life

KC-135 WEAPON SYSTEM

The KC-135 is AMC's core tanker. The core tanker must be capable of meeting the following requirements: 1) deploying, employing, and redeploying the full range of US and allied aircraft in support of combined, joint, and special operations in any environment; 2) completely supporting the SIOP mission; 3) surviving in a wartime threat environment; and 4) providing a large fuel offload with maximum flexibility. Additional tanker roles include training, peacetime contingency operations, cargo movement, and conventional taskings. In the future, KC-135s may

perform an aeromedical evacuation role. The KC-135 fleet has also begun regular cargo channel missions after successfully validating cost effectiveness and establishing a concept of operations. The test program established operational procedures and resulted in an overall improved cargo carrying capability for the aircraft. The development of a cargo roller system was an important step that allowed the KC-135s to provide a channel for low volume, high priority cargo. Acquisition of cargo rollers continues, but since the majority of KC-135s are dedicated to wartime air refueling, their impact to wartime airlift is limited.

Fleet Makeup
As of FY96, the KC-135 refueling fleet consists of 496 PAI. All A and Q model conversions to R models are complete. Some E models will be converted to R models. A mix of three different KC-135 models are now in use and are manned by both active duty and ARC aircrews. The description of the different models is below:

Table 5-1

KC-135 MODELS
KC-135E: TF-33 turbofan engine with thrust reverser
KC-135R: Reengined / Modernized KC-135A/E
KC-135T: Reengined / Modernized KC-135Q, which can isolate body fuel tanks and offload specialized fuels

Maximum cargo weight of the KC-135 is approximately 55,000 pounds; however, maximum loads are usually limited to approximately 35,000 pounds due to cargo volume and floor loading limitations. They can carry a maximum crew/passenger load of 58. Both cargo and passenger loads affect the maximum fuel load of approximately 200,000 pounds (R/T-model). These aircraft are capable of offloading to receivers with either the flying boom or the drogue basket. However, the KC-135 crew must know the receiver type prior to takeoff, because drogue/boom changes cannot be made inflight.

Depot Status
The number of aircraft in depot status and the duration of each PDM will be reduced. The PDM cycle will be extended from 4 years to 5 years and the current 9 months in PDM should be reduced to 7 months by FY97. These reductions will be achieved by the existing AFMC flowday reduction plan.

Reliability

Objective 1.3.3 *Modify the aging air mobility fleet to maintain the capability to meet future requirements.* XPQ, FY03

Objective 2.2.1 *Increase aircraft availability and reliability to meet command goals and requirements.* LGF, FY07

Mission capable rates are good (83.2% CY96) and will continue to be driven upward through careful analysis and application of reliability/maintainability processes. Mission Capable

Rates for Jan-Jun 96 are averaging 87.1%. Systems already identified for improvement are the radar system (APN59), the compass systems, the FSAS system, the aircraft brakes, the aircraft battery, and the air refueling boom. Improvements in the reliability/maintainability of these systems should reduce TNMCM and TNMCS rates to 7 percent.

Modifications

Completion of the R conversion is a crucial near-term step, significantly improving the KC-135's overall technology. Given the age of the basic aircraft, modernization of the avionics and communication equipment must keep pace with technology to keep this system as a viable force multiplier well into the future. A major effort to upgrade the KC-135 centers on the cockpit. Projected shortages in the navigator crew force, reduction in Specialized Undergraduate Navigator Training (SUNT) production, and the need to modernize the KC-135 cockpits caused us to re-examine the way we will conduct air refueling. The overall plan is divided into two phases: relocation of the navigator's avionics to the pilot's station and an avionics modernization.

...

New Air Refueling Pumps: Current pumps still have potential for overheating even after being modified with an auto-shut-off system designed to shut off pumps in a dry tank. AMC imposed operational restrictions on current pumps not allowing crews to go below 1000 pounds in the fuel tanks. New hydraulically cooled pumps will allow the lifting of current operational restrictions.
Avionics Relocation: With navigator reduction, cockpit equipment must be relocated or control functions duplicated so they can be controlled by the pilot and copilot positions. Relocation of equipment is needed to ensure continued operation once navigators are removed from the cockpit.

...

Re-Engine KC-135Q/E: Replaces existing J-57/TF-33 engine with the more powerful, efficient CFM-56 engine. Increases fuel offload capability by 50 percent, reduces fuel consumption 25 percent, and reduces takeoff distance 20 percent. The quieter, cleaner CFM-56 meets or exceeds all FAA/ICAO Stage III noise and pollution standards. Seven KC-135Es are currently scheduled to be re-engined.

...

Window Edge Heater: Installation of window edge heaters will extend service life of cabin windows by negating the moisture intake around the window edge. Increases MTBF from 1,500 to 20,000 flight hours.

Multi-point Refueling. Adds wing tip pods with refueling drogues so KC-135 can refuel with boom and/or drogue on same flight. Increases capability by providing redundant A/R points on a single tanker and increases interoperability with Navy, Marines, and allies.

A/R Boom System Improvements: Improves ruddervators, pivot joints, and boom nozzle with an

independent disconnect capability for the boom operator. Enhances safety by adding the independent disconnect capability and will decrease the amount of inadvertent disconnects by increasing the usable air refueling envelope.

Improved Main Landing Gear Brake Wear: Installs self-adjusting piston to the brake assembly, reducing wear and extending brake life 30 percent.

Improved Latrine: With the KC-135 being used for airlift, the latrine is inadequate for carrying passengers on long missions. Need an expanded latrine with external dumping capability.

Follow-on Studies: Begin studies to examine follow-on tanker options. Long lead time for modifications and acquisition require studies to begin early to ensure continued capability.

Sustaining Engineering

To sustain the baseline capabilities of the KC-135 and associated non-aircraft systems the command is contracting engineering services. Contractors will analyze reliability, maintainability, supportability, and performance deficiencies. The engineering efforts requiring funding are identified in the sustaining engineering requirement plan (SERP) and are listed below. The studies will verify the need for change, develop life-cycle costs, and perform trade-off analysis. The studies may lead to further research, development, testing, and evaluation (RDT&E) initiatives and future modifications to the aircraft. This effort covers the future-years defense program (FYDP) period.

The highlight of the KC-135 sustainment program is its aging aircraft initiative CORAL REACH. As this program matures, new nondestructive inspection programs, new/improved structural repair processes and replacement procedures, and parts never before stocklisted and procured will be identified.

TASKS
System Engineering
Safety
Aircraft Structural Integrity Program
CORAL REACH
Circuit Breakers
Electrical Wiring Replacement Program (EWRP)
Sustainment
Reliability & Maintainability
Functional System Integrity Program (FSIP)

Service Life

Most experts agree that the R-model and T-model will continue to operate economically well into the next century. The R-models maintenance capability and reliability rates are among the highest of any weapon system AMC operates, and its operating cost is the lowest. The E-model economic service life is markedly different because of the difference in age and technology of some of its major components, most notably the engines. The basic airframe

should, in theory, last as long as the R-model, but the age of the engines points to the likelihood that upkeep could become expensive (in terms of parts and maintenance man-hours). The TF-33 (E-model) engines were previously used but refurbished to an expected 6,000 hour service life. At current use rates, the TF-33 will need another major overhaul around the turn of the century. Additionally, since the TF-33 does not meet FAA Stage III noise requirements for the year 2000, more time and money must be expended to ensure compliance. Oklahoma City-Air Logistics Center (OC-ALC) is pursuing a solution to TF-33 compliance in conjunction with the OPEN SKIES modification efforts. Considering most E-models operate from joint use fields, FAA Stage III compliance is a must. The R-model conversion with its improved CFM-56 engines meets FAA Stage III noise requirements, promote commonalty, and offer the necessary service life extension to keep pace with the rest of the KC-135 fleet. In the absence of the R-model conversion, studies should begin now to determine the feasibility of continuing to operate the E-model into the 21st century.

Aircraft corrosion presents a significant challenge to AMC. It is presently difficult if not impossible to model this major life limiting factor over long periods of time. As we operate aircraft for an unprecedented number of years, we find ourselves dealing with an old problem with no apparent new answers. Technologies required to deal with corrosion have not evolved, leaving AMC with a deficiency-that of not knowing exactly how long its older aircraft will operate economically.

At current use rates, KC-135 aircraft are projected to be in Air Force service well into the next century. In fact, calculations using a predicted service life of 70,000 hours (structural data only) and based on current annual flight hours reveal a notional service life extending into the 2200 century. However, these numbers taken alone are misleading as they do not include the effects of corrosion. While it is not known how much corrosion will affect service life, it is certain there will be some affect. The corrosion factor causes us to doubt whether the KC-135 can continue to operate economically over the next 25 years.

AMC therefore places special emphasis on the development of technologies required for accurate service life predictions with the effects of corrosion included. Depending on the speed of technology advancement, OC-ALC may be able to determine the economic life of the weapon system in FY97. These efforts notwithstanding, AMC's goal is to accurately define the KC-135's service life, with the effects of corrosion included, by FY00. Until corrosion studies can validate an accurate KC-135 economic service life, AMC will fully validate a potential retirement and replacement date for the KC-135.

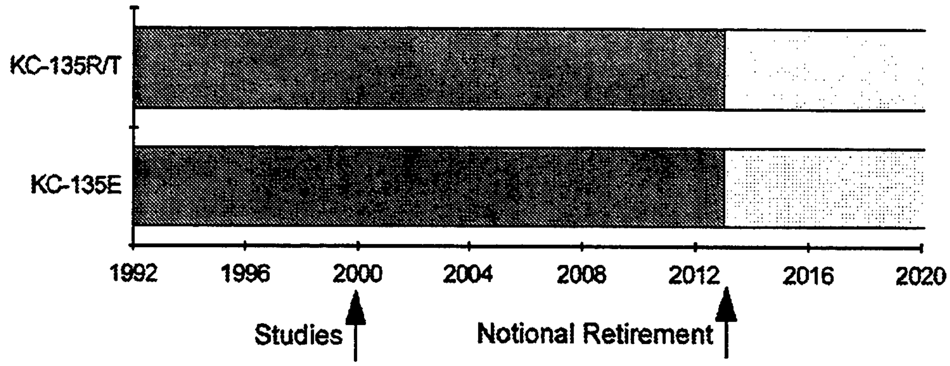


Figure 5-12. KC-135 Service Life

AEROMEDICAL EVACUATION (AE)

The nation has an overriding moral responsibility to guarantee its armed forces the quickest, most humane casualty evacuation system possible. This guarantee enhances the morale of the troops in the field and the American public. This enhanced morale translates into increased staying power on the battlefield and the home front.

Ninety-three percent of the current AE force structure is incorporated in ARC units. Four active duty AE squadrons provide both a baseline support capability for contingency transition and day-to-day urgent, priority, and routine aeromedical evacuation operations within Europe, the Pacific, CONUS and near off-shore locations. The ARC supports these active duty units by providing AE crew members for 85-90 percent of the intertheater AE mission, 100 percent of the off-shore AE missions (e.g. Alaska and Panama), and approximately 25 percent of CONUS missions.

AF reorganization efforts moved overseas active duty aeromedical evacuation squadrons under their respective theaters and intratheater AE forces to HQ ACC, but AMC remains responsible for providing intertheater and CONUS AE and will serve as the AF advocate for aeromedical evacuation. As such, AMC will continue to be a central focus for issues affecting the worldwide AE system, ensuring that separately operated theater AE systems can interface globally, standardizing doctrine, publications, force equipping, training, and organizing of the worldwide system with input from each theater and ACC for intratheater-specific elements. Management and planning activities will require continual coordination and cooperation between the six MAJCOMs and the ARC which provide aeromedical forces.

There are currently 18 PAI C-9A aircraft in the AF inventory, 11 of which are assigned to AMC. AMC-owned aircraft are manned at a 3.5 crew ratio (2.0 active plus 1.5 Reserve Associate). The ratio for FY97 will adjust from 3.5 to 3.3 (1.55 active plus 1.73 Reserve Associate). For FY98, the ratio will reduce from 3.3 to 2.9 (1.0 active plus 1.9 Reserve

Associate). These aircraft are the only dedicated AE aircraft and supported by CLS at the depot level. Air Force support consists of organizational and limited intermediate-level maintenance, restricted to a "remove and replace" concept. Supply support is provided by COMBS.

C-141 aircraft perform weekly strategic AE missions supporting USEUCOM, USPACOM, USCENTCOM, and USSOUTHCOM. While C-130s are not normally scheduled for peacetime AE missions, they occasionally provide backup support to C-9As. However, C-130's would be the primary means for moving casualties out of the combat zone during contingency operations. The C-17 will provide follow-on strategic support as the C-141 fleet is retired and can support intratheater AE in accordance with the theater coordinated concept of operations. C-5, KC-10, and KC-135 aircraft are potential sources of emergency AE lift if the need arises. Other aircraft that can support the AE mission include: C-21 and C-12, which may be used for unscheduled, immediate AE requirements. A staff effort is under way to determine aircraft availability, conceptual feasibility, aircraft/medical compatibility, and cost.

In addition to this organic capability, the DoD relies on the capability of the aeromedical segment of the CRAF, composed of commercial passenger Boeing-767s, which can be configured with specially designed aeromedical ship sets to carry up to 111 litter patients. The B-767 offers effective, modern AE capability. It will also be used to reposition medical crews, equipment, and supplies to the theater, but more importantly, it frees strategic aircraft to perform strictly in the mobility role.

Modifications

AE presents the dual challenge of keeping up with technology in both aviation and medicine. The command will remain dedicated to keeping its aircraft and aeromedical capabilities up to date. The fleet received an interior refurbishment to ensure it remains capable of meeting future passenger and patient requirements.

Future

The C-9A entered service in 1968. Considering service life based on flying hours, these aircraft could theoretically fly beyond 2020 (Figure 5-17). However, it may not be economically prudent to do so. As the fleet continues to age, the issue of supportability and maintainability will become more and more important. The aircraft manufacturer, McDonnell Douglas, has acknowledged this fact by instituting an aging aircraft program for the DC-9. The Oklahoma City Air Logistics Center monitors this aging aircraft program to determine which are applicable to AMC operations. The C-9 relies heavily on a commercial logistics support base. As first tier civil carriers retire their aging C-9 fleets, it may become prohibitively expensive for AMC to maintain its small, unique fleet. In addition, FAA noise compliance regulations are implemented at the turn of the century. For this reason, Aeronautical Systems Center performed an economic analysis in 1992 to compare the future life cycle cost of maintaining the C-9 fleet, upgrading it, or replacing the C-9 with current technology aircraft. Results indicate approximately equal costs for re-engineering or installing hush kits on C-9s. This is a lower cost option than buying new aircraft. Therefore, we have initiated a working group to develop the best course of action for

meeting mission, as well as FAA/ICAO noise requirements.

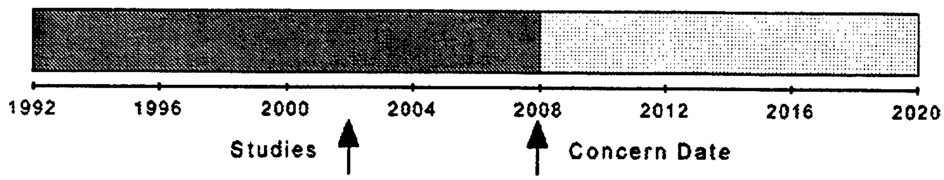


Figure 5-17. C-9 Service Life